March
25 Cents

The WIRELESS AGE

America's Foremost Radiophone Review

In this issue:

Police Protection Plus

Broadcasting in Britain

Cuba Comes In

And a Complete Review of the World of Wireless

Pictorial
views With Air Entertainers
And Other Feature Articles

The Trans-Atlantic Triumph

Filament potential	5 volts
Filament current	.25 amp.
Plate potential	20 to 100 volts
Plate impedance	16,000 ohms
Amplification constant	6.5

Immediate Demand for New

Cunningham

Amplifier Tube

Type C-301-A **List Price $9.00**

The most efficient vacuum tube ever placed on the market for amateur and experimental use. The engineers of the General Electric research laboratories have at last succeeded in perfecting a tube that every owner of a radio set has been waiting for.

Greater Power Amplification
Only ¼ Amp. Filament Current

THIS new and improved Cunningham C-301-A Amplifier is a high vacuum tube designed for use as an amplifier and detector, containing a new Tungsten Filament, the characteristics of which are long life, low power consumption, low operating temperature and greater power amplification than any previous amplifier tube. The tube has a standard four prong base, and the glass bulb has the same dimensions as the C-300 and the C-301.

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Complete instructions for the care and efficient operation of this new Amplifier Tube are packed with every tube.

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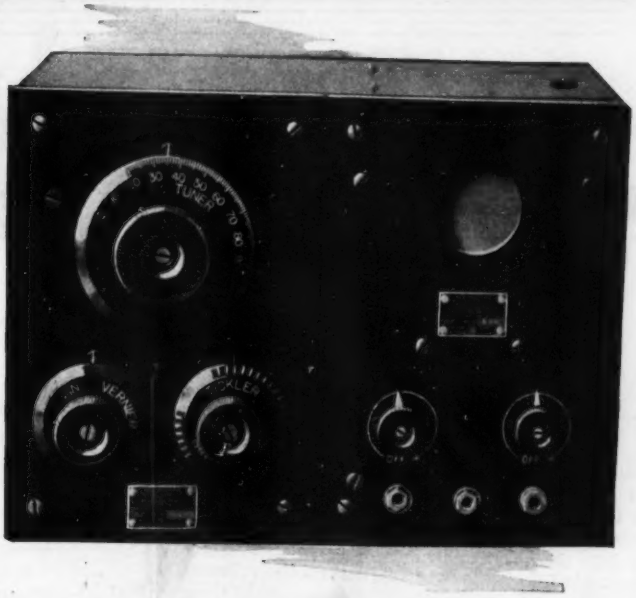

In TRENTON, he hears stations 1500 miles away with Radiola RC

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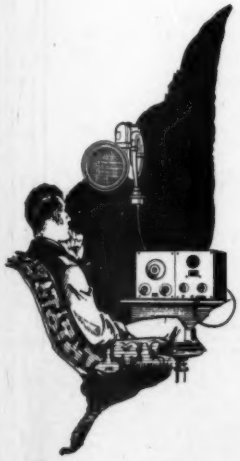

To find out what Radiola will fit your needs and purse, write for free illustrated booklet "Radio Apparatus for Broadcast Reception."

J. T. K. Hudnut, Secretary and Treasurer of the Trenton Electric Supply Company, recently wrote and said about Radiola RC:

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This is but one of thousands of letters received in which owners of Radiola RC have commented on its remarkable range. Half the delight of radio lies in this ability to pick up the far stations.

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The price of Radiola RC is $132.50. Examine it at any RCA dealer. If there is none near you, write to us and we shall put you in touch with one.

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Volume 10 *Edited by* J. ANDREW WHITE *Number* 6

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Because certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signalling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

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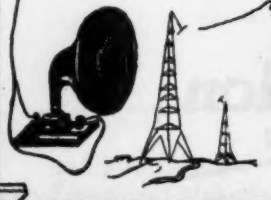

"America's Foremost Radiophone Review"

THE WIRELESS AGE is a member of the Audit Bureau of Circulation.
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Philadelphia

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"Picks the Signals Out of Squeals"

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View of BASCO Vernier Rheostat showing resistance coils.

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Condensite Celoron Radio Panels

cut in standard sizes

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5. — 9 x 14 x 3/16
6. — 7 x 21 x 3/16
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Select the size you need for your set. If your radio dealer has not yet stocked them, ask him to order for you. Or write direct to us, designating by number the size you want. We can make prompt shipment.

To radio dealers: Write for special dealer price list showing standard assortments

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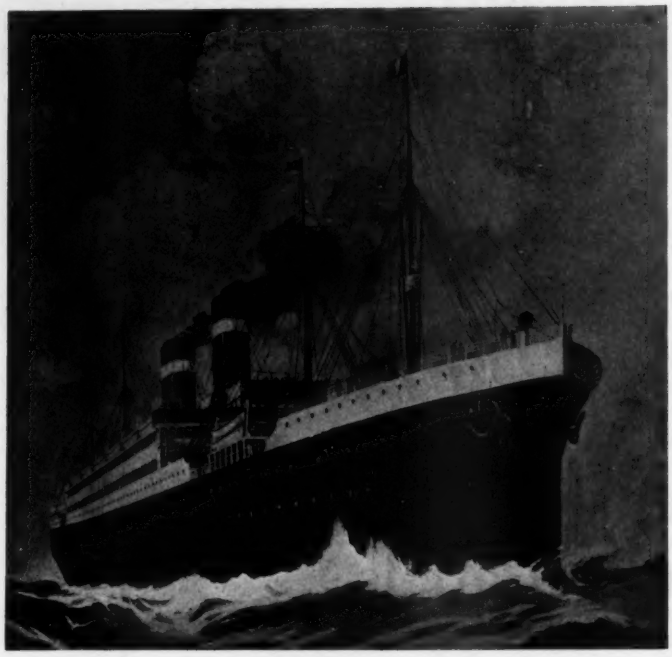
CONDENSITE CELORON STANDARD RADIO PANEL



AROUND THE WORLD AND PAID FOR IT!

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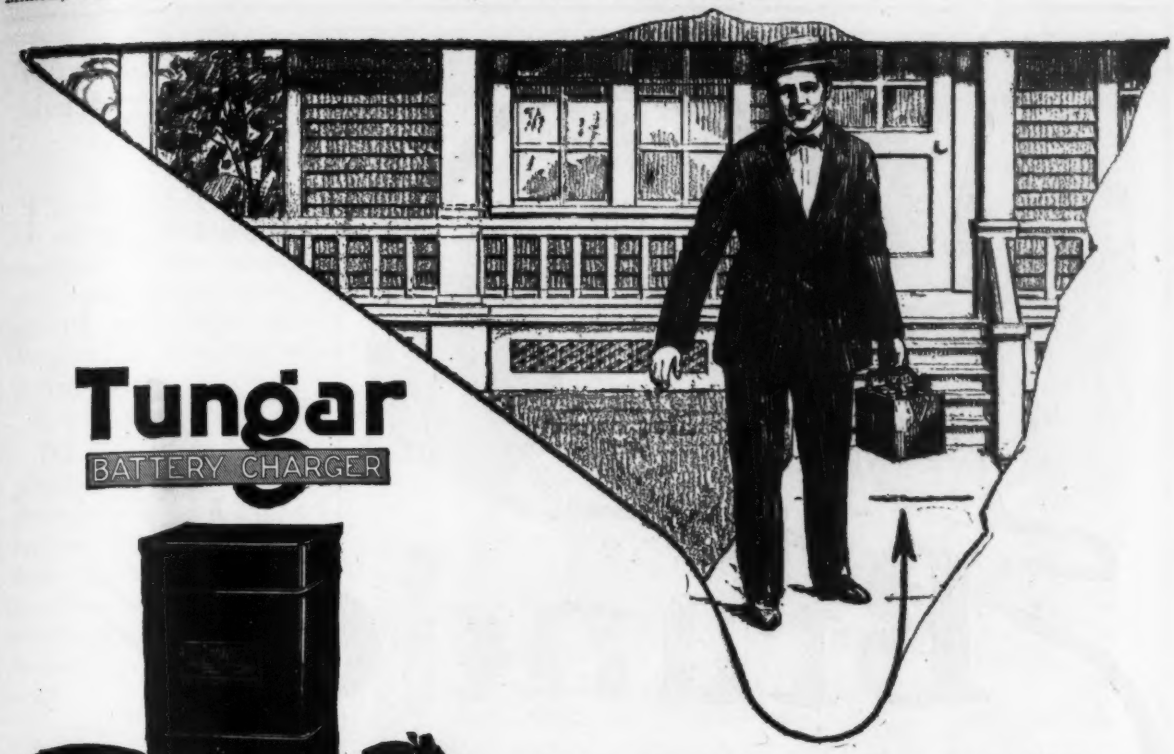
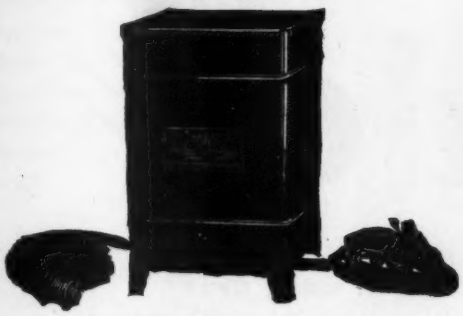


Tungar
BATTERY CHARGER



Tungar Battery Charger—keeps your battery at home. Also, with simple attachment, charges "B" storage batteries.

This is the way "B" Storage Batteries are charged with Tungar and attachment.

No Need of Doing This

Is yours a tube set?

Yes? Then you have a storage battery which frequently requires recharging.

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A Tungar Battery Charger enables you to recharge your storage batteries for either radio or automobile use right at home—easily, quickly, and at little expense. It operates from any a-c. lighting circuit.

Any one can operate a Tungar. Once started, it requires no attention; nor is there the slightest danger of injuring the battery.

The initial cost is low; the operating cost is little. Send for our new booklet on Tungar for radio, if your dealer cannot supply you. Address Merchandise Dept., General Electric Company, Bridgeport, Conn.

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General Office Schenectady, N.Y.

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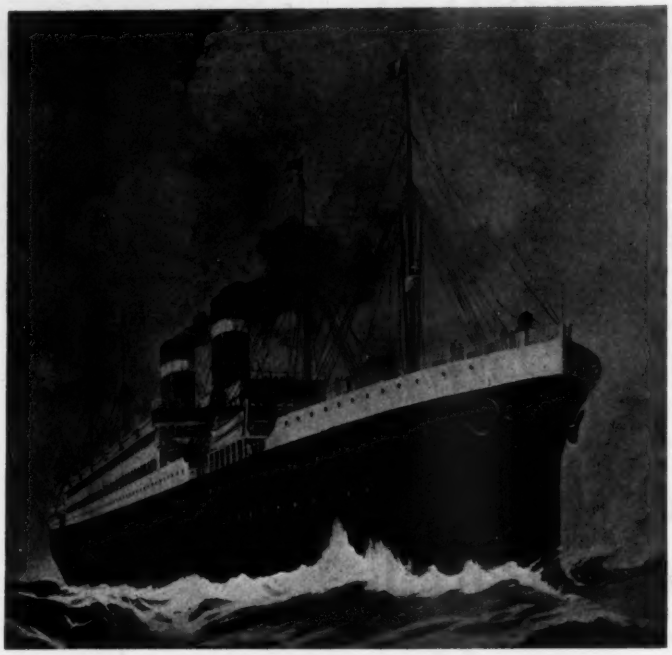

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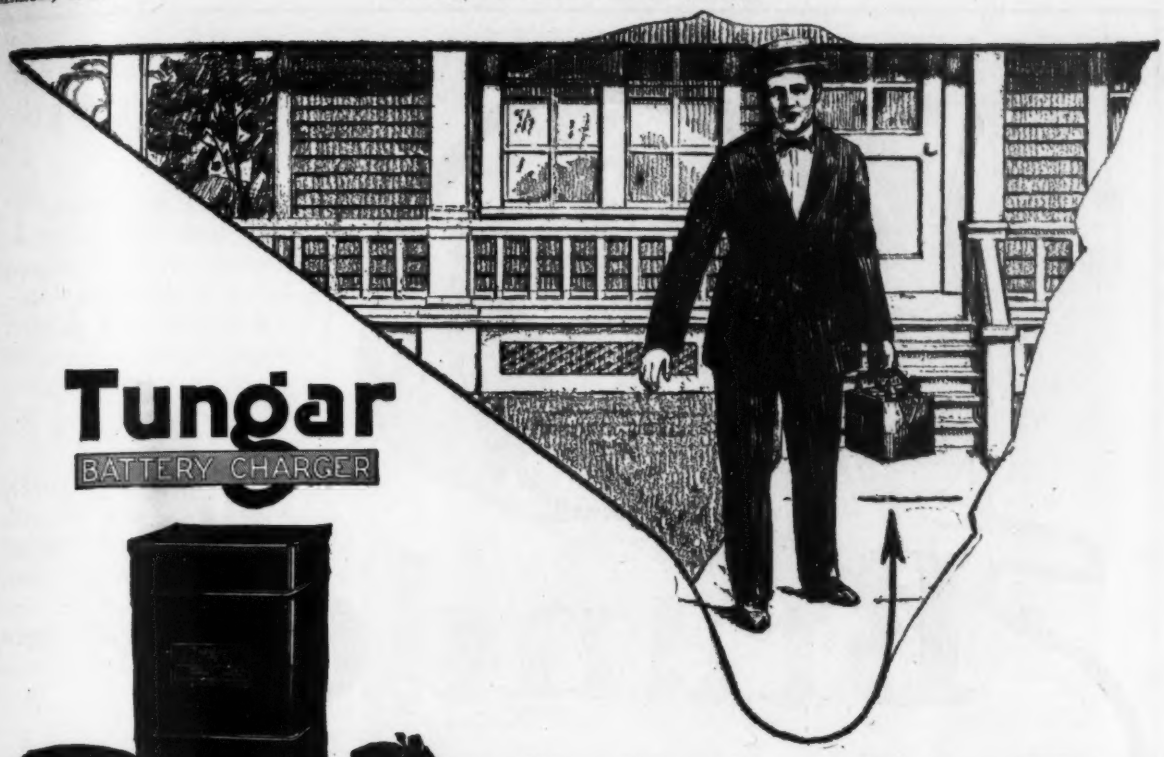

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General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

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Brandes

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Even this is made more interesting when the two receivers in the headset are matched in tone and thus made to sound exactly alike. For this reason Brandes *Matched Tone* Headsets excel. They are more sensitive; also more durable, more comfortable. Ask your dealer for a Brandes *Matched Tone* Headset *if you want the best results.*

¶ *Send ten cents in stamps for the "Beginner's Book of Radio." It explains radio in terms that anyone can understand.*

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TRADE MARK REG. U.S. PAT. OFF.

Radio Headsets

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This Combination Completes any RADIO RECEIVING SET

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R-3 Magnavox Reproducer with 14-inch curvex horn: ideal for homes, offices, etc.

Model C Magnavox Power Amplifier insures getting the largest possible power input for your Magnavox Reproducer . . 2 and 3 stage

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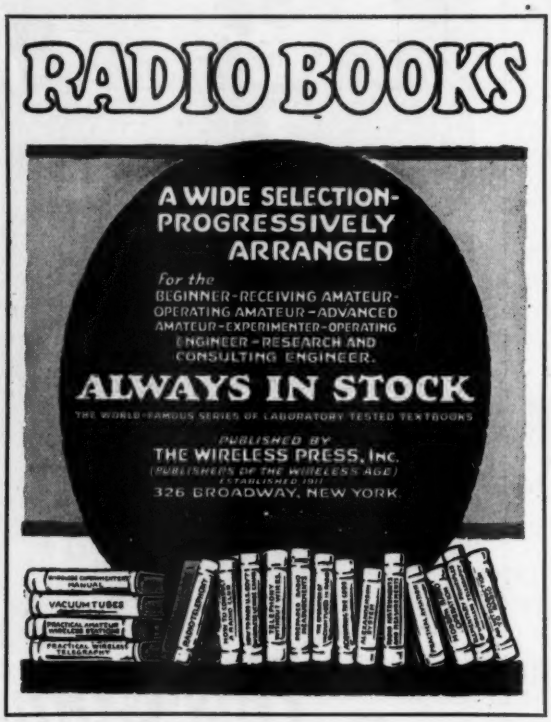
These books tell you what radio is, what it does and how it does it.— They give you the fundamental facts.



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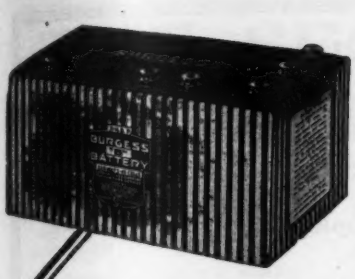

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—ARE RECOMMENDED by leading manufacturers of radio equipment.

—ARE SPECIFIED by radio engineers.

—ARE DESIGNED and built by radio engineers.

—ARE A GUARANTEE of satisfactory service.

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Burgess Radio Batteries are handled by all progressive jobbers and dealers. Look for the distinctive black and white stripes. If your dealer doesn't handle the Burgess line just address the nearest Burgess office below.

Burgess No. 6 Batteries

Are highly recommended for use in "A" or filament circuits where one and one-half volts Vacuum Tubes are used.

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Winnipeg Toronto Montreal

"ASK ANY RADIO ENGINEER"

BURGESS
RADIO BATTERIES

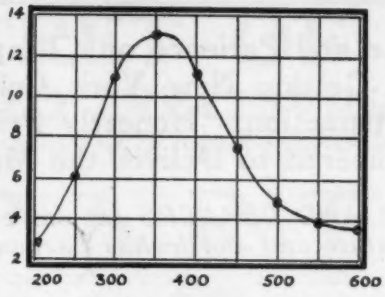


CHART I

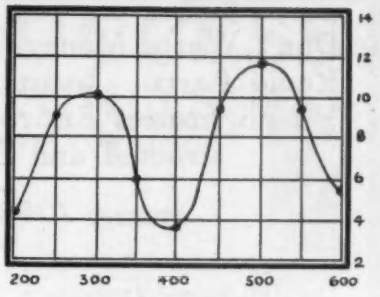


CHART II

How to get distant stations clearly

Why the Acme Radio Frequency Transformer eliminates distance and distortion

BEFORE you purchase a radio frequency amplifying transformer find out if it has marked depressions and peaks in its amplification range between 250 and 500 meters (indicating absence of amplification in the depressions)—or whether the amplification range curve is uniform.

A test

THE two charts above tell a graphic story of tests made on radio frequency transformers in the laboratories of a well known concern. The chart at the left plots the amplification range curve of 12 Acme R-2's taken from stock. (Note: The Acme R-2's are made with a special iron core and windings.) The chart at the right represents a composite plot of the curves of 6 ordinary types of different makes taken from stock. The superiority of the Acme R-2 is self evident. Note its steadily increasing amplification curve with its maximum at 360 meters—just where it is most needed.

Better results—greater distance

TO HEAR the distant station is not enough. To understand them—to be entertained by them—that is the real thrill. The Acme R-2 used in a radio frequency amplifier builds up wave energy without distortion before passing it on to the detector. Even the simplest and most elementary type of set, either vacuum tube or crystal receiver type, will have its useful range tremendously increased when the Acme R-2 and a vacuum tube are employed.

Acme R-2 Radio Frequency Amplifying Transformer. Price $5.00 (East of Rocky Mountains)

The best method

TO GET the distant stations clearly, use Acme Radio and Audio Frequency Amplification. This insures maximum sensitivity and intensity, quietness in operation and freedom from distortion. A small indoor antenna or loop may be used and sufficient intensity obtained to operate the Acme Kleerspeaker providing perfect entertainment for a roomful of people.

You can get these and other Acme Products at radio, electrical and many hardware stores. Write for booklet R-2 showing proper hookups and other information.

The Acme Apparatus Company

Pioneer Transformer and radio Engineers and Manufacturers

CAMBRIDGE, MASS., U.S.A.

NEW YORK, 1270 Broadway
CHICAGO, 184 West Washington Street

ACME *~ for amplification*

Don't Waste Money, Time and Patience on Cheap, Improperly Designed Radio Parts. Insist on Getting New York Coil Company's Products, Which Insures Entire Satisfaction. Honestly Priced, Scientifically Constructed and Engineered to Deliver the Maximum Results.

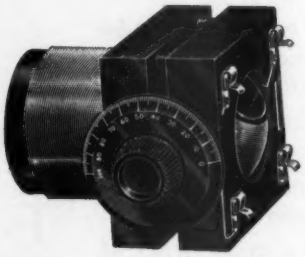
JOBBERS AND DEALERS get our complete literature and worthwhile discounts.

Our 180-degree Variocoupler is a masterpiece, suitable for use in any circuit. Most efficient and best constructed Coupler in existence. Price..... $4.50

STANDARD 90-Degree COUPLER FORMICA TUBE, Price $3.50

MOUNTED 3-CIRCUIT TUNER

Exceptional selectivity and sharp tuning, makes the most easily constructed and highest efficiency Set known. Price without dial..... **$6.00**

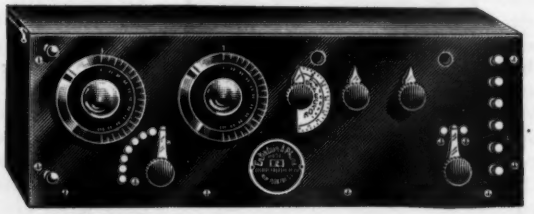


Our Combination Mounted Variocoupler for table or back panel mounting has all taps connected and soldered—nothing else like it. Price..... $8.00

Our Variometers are full size, precision instruments. They are not of the competitive type. Price **$4.00**

Our Audio Frequency Transformers are the choice of leading manufacturers and radio engineers. Guaranteed to give high magnification, less distortion and better all 'round efficiency. No howling. Price **$4.00**

NEW YORK COIL COMPANY'S Variable Condensers are the standard by which others are judged, containing such features as all metal frame work, adjustable bearings and positive electrical contact—
11-Plate....**$1.50** 23-Plate....**$2.00** 43-Plate....**$3.00** 3-Plate.....**$1.25**



NEW YORK ENTERTAIN-A-PHONE RECEIVING SET No. 2—Complete with detector and two stages of amplification, all in one cabinet. Contains a non-regenerative two circuit hook-up with two stages audio amplification. Results are simply a revelation. It must be operated and heard to be appreciated. Workmanship and design and material of exceptional character throughout. Of unusual interest to the jobber. Price **$50.00,** fully guaranteed.

NEW YORK COIL COMPANY, Inc.

338 Pearl Street
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SPARE TIME MONEY

Turn some of your spare time into money by securing subscriptions to

The America's Foremost Radiophone Review
WIRELESS AGE

Many radio enthusiasts find this an easy way to get the money to pay for their new apparatus and books.

For particulars write
SUBSCRIPTION MANAGER
The WIRELESS AGE, 326 Broadway, New York

THE SECRET OF SUCCESS
IN RADIO RECEIVING UNITS
LIES IN THE EFFICIENCY OF THE VARIOUS
PARTS —

Audio Frequency Transformer

Grid Leak Mounting and Condenser

Grid Leak Resistance Unit

Radio Frequency Transformer

Federal

Potentiometer

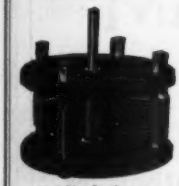
SCIENTIFICALLY DESIGNED
MECHANICALLY CONSTRUCTED
HIGHEST GRADE MATERIALS

Head Telephones

Federal

RIGIDLY INSPECTED
THOROUGHLY TESTED
FULLY GUARANTEED
Universally Accepted as The Standard

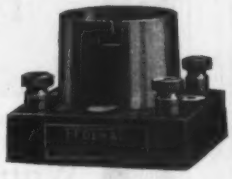
Rheostat

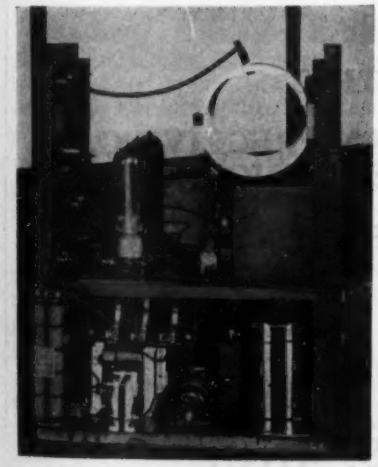

Variable Condenser

Federal STANDARD PARTS

are now available to those who desire to assemble their own sets.
FOR SALE BY LEADING DEALERS
Write for descriptive literature and prices

Federal Telephone & Telegraph Company
MANUFACTURERS OF STANDARD RADIO EQUIPMENT
BUFFALO, NEW YORK


V. T. Socket



Why an Amateur License?

BEFORE you can operate that telegraph or telephone station you are planning to erect you must get your Amateur's License from the U. S. Department of Commerce. You must be qualified to receive the Continental Morse code at ten words per minute and possess an understanding of radio technique as well as knowing certain radio rules and regulations governing the operation of an Amateur station.

Do you understand the theory of radio communication as well as the practice and vice versa?

The RADIO INSTITUTE OF AMERICA can quickly qualify you for that Amateur License in either its afternoon or evening classes.

Full particulars gladly sent upon request.

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THE WIRELESS EXPERIMENTER'S MANUAL

E. E. BUCHER

THIS IS THE BOOK YOU WANT

It will answer all your questions about wireless telephony and telegraphy

Written Especially for Amateurs by one of the foremost authorities.

Complete instructions for

CONSTRUCTING

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A COMPLETE TRANSMITTING AND RECEIVING STATION INCLUDING THE RADIOPHONE

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—And they're all talking at once these nights! If you want what you want when you want it, you might as well stop struggling with single-circuit receivers.

Under present conditions, with several hundred powerful broadcasting stations all operating on one narrow wave band, the single-circuit receiver is utterly inadequate to give you satisfactory results.

The Paragon three-circuit receiver gives you the station you want when you want it — *and no other*. You can tune in accurately on any station and get a clear, complete program without interruption or disturbance.

Ask some experienced amateur what he knows about

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

The amateur will tell you that the Paragon three-circuit receiver, because of its greatly superior selectivity and sensitivity, can pick and choose between broadcasting stations of about the same signal strength with less than one per cent differential.

This means that with a Paragon receiver you get what you want when you want it—complete messages and clear music from the station you tune in on, without interruption and jamming. Until you have listened in with a Paragon three-circuit receiver, you cannot guess the real pleasure and fascination of radio.

Long before broadcasting popularized radio with the general public, Paragon equipment was the choice of the experienced amateur. He will tell you today that if you want quality and satisfaction, Paragon Radio Products are the best and safest buy on the market.

An illustrated Catalog of Paragon Radio Products is Yours For the Asking

DEALERS — The Adams - Morgan Company has an interesting proposition to make to reputable radio dealers who believe in quality merchandise. Details on request.

ADAMS-MORGAN COMPANY
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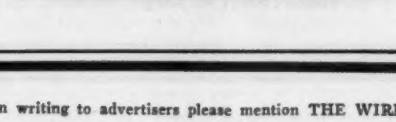
Also Manufacturers of PARAGON	
Radio Telephone Transmitters	Amplifier Transformers
V. T. Control Units	Control Dials
Rheostats	Amplifiers
Potentiometers	Receivers
V. T. Sockets	Switches
Detectors	Variometers

Type RD-5 Regenerative Receiver and Detector—$75.00
Type A-2 Two-Stage Amplifier—$50.00
(Licensed under Armstrong Patents.)



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Reliable Radio Specialties

for Good Results!

THE name "Pruden" back of standard Radio Equipment is a guarantee of mechanical excellence and scientific correctness of design. You can pin your faith to "Pruden." Money-back unconditionally if you do not get complete satisfaction.

Just a few leaders of Pruden Reliable Products shown here that will give you better radio results at no greater cost.

PHONO-PHANE PERMANENT
Radio Detector

The only fixed radio detector requiring no adjustment. Used in place of crystal or vacuum tube detector. Gives excellent quality of sound without distortion. Detects signals at several thousand miles more clearly than vacuum tube detector.

List $3.50

Single Hole Panel Mounting

No. 104 Vernier. Requires only ¾" hole in panel. List.....$1.50

No. 123—23 Plate .0005 Mfd. requires ⅜" hole in panel. List $3.50

No. 143—43 Plate .001 Mfd. requires ⅜" hole in panel. List.....$4.50

Dealers write for our interesting proposition

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INCORPORATED
999-W Bergen Avenue
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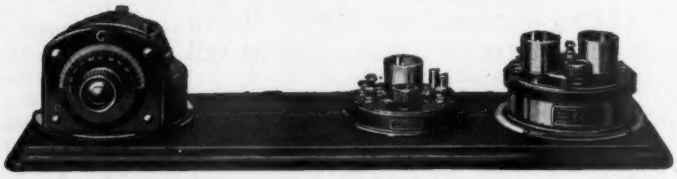
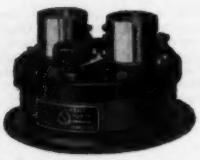
ATWATER KENT

Receiving Sets and Parts

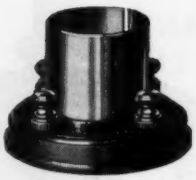


Complete sets include: Coupled Circuit Tuner, Detector Unit, and 2-stage Amplifier; or Coupled Circuit Tuner, with Detector—1- or 2-stage units.

Mounted Variometer



Detector 1-stage Amplifier



Standard Tube Socket

1½-Volt Tube Socket

ATWATER KENT products sell on appearance; they stay sold on quality of performance.

This is the reason for the popularity of ATWATER KENT Radio Equipment.

Look over the illustrations. They show a portion of the line, which includes complete sets, as well as parts from which the radio fan may build his own receiver.

There are several sets made up of various combinations of the different units. All are mounted on mahogany bases and wired ready to attach to antenna and battery. No bothering with hook-up.

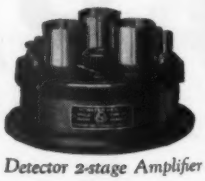
Use a set as YOUR demonstrator

These sets are attractive enough in appearance to be installed in the most "exclusive" home or club; moderate enough in price to be within reach of anyone; and excellent enough in operating qualities to satisfy the most particular.

For the fan who wants to experiment with varying hook-ups there are parts which will meet every requirement.

ATWATER KENT Radio Sets and Units sell readily and are a very profitable line.

Mounted Variocoupler



Detector 2-stage Amplifier

Type L Transformer

Condensite Dial

They're Always SEEN in the Show Windows

ATWATER KENT MANUFACTURING COMPANY, PHILADELPHIA, PA.

Radio Department 4946 STENTON AVE. *Write for Literature*

In Our Opinion

THE number of broadcasting stations is now on the decline, which should be good news to listeners.

A Return to Normalcy

The point of saturation, the high peak of interference and useless duplication of effort was reached during January last, when there were 581 stations more or less in active operation and ranging in power from 5 watts to 5 kilowatts. Then the curve of the broadcasting chart began to droop and by the end of the month 34 stations had dropped out, while only 5 new ones were licensed, leaving an active January total of 552.

It now appears that there is relief in sight for a situation that long ago became impossible and intolerable. That the high point has been passed is a hopeful sign coupled with the expectation that next month's totals will show still further progress toward a return from the present impossible situation to one of normalcy. Eventually a few high-class stations will render a complete and satisfactory service to the greatest possible number of listeners.

* * *

TO date there has been no report that the new British Broadcasting Company's stations have been heard in the United States. This is not strange, nor is it any indictment of American apparatus or experimenters that the English hear American broadcasting regularly while Americans accomplish nothing in the reverse direction.

Programs Across the Sea

Two conditions are responsible, one natural and the other artificial. The natural obstacle is the difference in time, five hours, running against America, so that the British stations are about through for the night just when the evening programs are commencing in 500 stations here. The artificial obstacle is interference from the multiplicity of American broadcasters. The Britishers have practically no local interference; and they have had the best section of the night to listen in for the United States.

It would be a rash prophet who predicted that any given problem in radio is incapable of solution, but certainly this particular prospect is anything but bright right now.

* * *

AS long as radio interested only the professional and the often no less expert amateur there was no particular necessity for standards. Users knew what they were about, and when they didn't, welcomed the opportunity for experiment and research, which they pursued with skill and frequently considerable engineering knowledge.

Standardizing the Radio Industry

Now, however, the turn of events has brought multitudes of the general public into the ranks of the radio enthusiasts, and the leaders of this great new industry have realized for some time the vital necessity for standardization of all parts and values used in all branches of radio. The old-timer and the newcomer may rejoice together that such standards are now well on the way to practical development.

* * *

THE trans-Atlantic experimental work done by Amateur Station 2ZL at Valley Stream, L. I., during the past winter has definitely settled one important question for the transmitting amateur. It has been definitely established that signals from American amateur stations of 100 watts or more of C. W. power can be successfully transmitted across the Atlantic for only two months in the year—from November 15 to January 15, approximately.

Trans-Atlantic Possibilities

And what is true of amateur work is also true of broadcasting, the height of effective trans-Atlantic broadcasting having been reached on December 23, when station WGY, Schenectady, N. Y., was heard in London on a two-foot loop, and a permanent record of music from WDAP was made on December 21.

Low-powered, short-wave voice and telegraphic signals may be heard across the ocean at odd times on in-and-out swings, but dependable, consecutive reception is possible only two months of the year, the best reception coinciding with the shortest day.

* * *

SINCE the advent of broadcasting there has been continuous controversy between the transmitting amateurs and the broadcast listeners over "the right of way." It appears that the broadcast listeners outnumber the amateurs about 50 to 1, so frequently the question has been raised: What useful purpose, if any, is served by the transmitting amateur and why is he allowed to continue operation.

Emergencies and the Amateur

Perhaps the best answer has been to recall the invaluable service of the American amateur to his country during the World War.

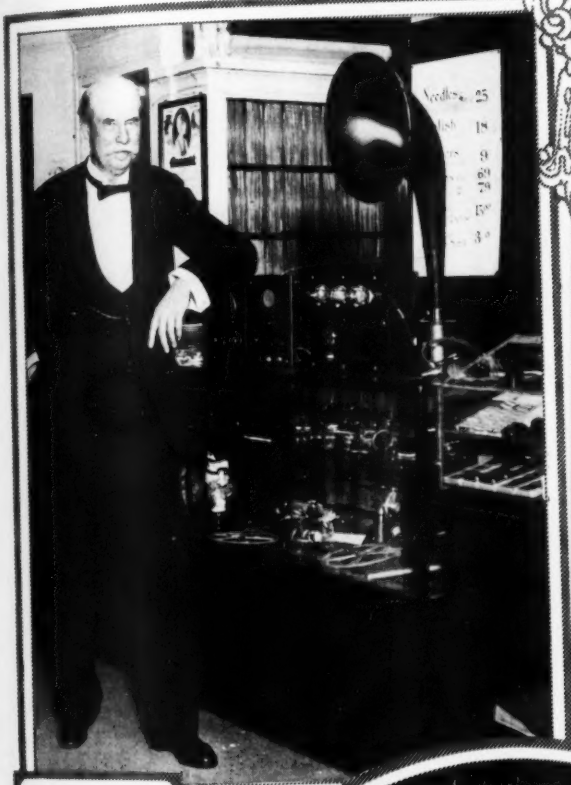
But there is another; and it is worthy of note, while the example is before us. It is concerned with the recognition due for valuable services in peace-time emergencies.

The latest demonstration of emergency communication occurred during an unusually severe sleet and snow storm in the Rocky Mountains of Colorado and Wyoming. The snow was fifteen feet deep in places, completely blocking railroad traffic, and two train-loads of passengers were caught and snowed in. All the wires were down, and the regular communicating system was entirely useless. An amateur radio operator, at Casper, Wyo., was called upon by the railroad officials; he established communication with other amateur stations located at Denver, and succeeded in obtaining and furnishing information that enabled intelligent dispatching of assistance and eventual opening of the line to normal traffic. Through the amateur stations a train of livestock was held at a terminal, where there were facilities for feeding and watering, whereas it might have been caught in an isolated spot in the mountains and detained indefinitely, resulting in serious consequences to the cattle.

So even if amateur radio may sometimes be annoying to the laymen, its ability and readiness to render assistance is of more than passing importance—it is a reason for its continued existence.—THE EDITOR.

ROSA PONSELLE flashed like a meteor from cabaret to vaudeville to grand opera, in which she astonished the world at 21; she is one of the brightest stars of the opera, and as told on page 31 she has delighted thousands by radio as well as by opera

Heard on the Air and Seen in Photographs



Sir Thomas Lipton, as told on page 32 is a great radio fan. Here he is seen in America, listening to the program just before making his trans-Atlantic test

Here is Miss Mary Alden. Don't recognize her? Most of her movie parts are those of old women, but she is really a charming young lady as you learn on page 30

Radio and exercise help Miss Dorothy Knapp to hold her title of "the most beautiful girl in America," as told on page 26. Keeping fit is a pleasure by radio

New Radio Stunts Snapped at Home and Abroad

A toast to radio in good old London, where the Penton Arms Alehouse entertains its guests in the old and modern ways

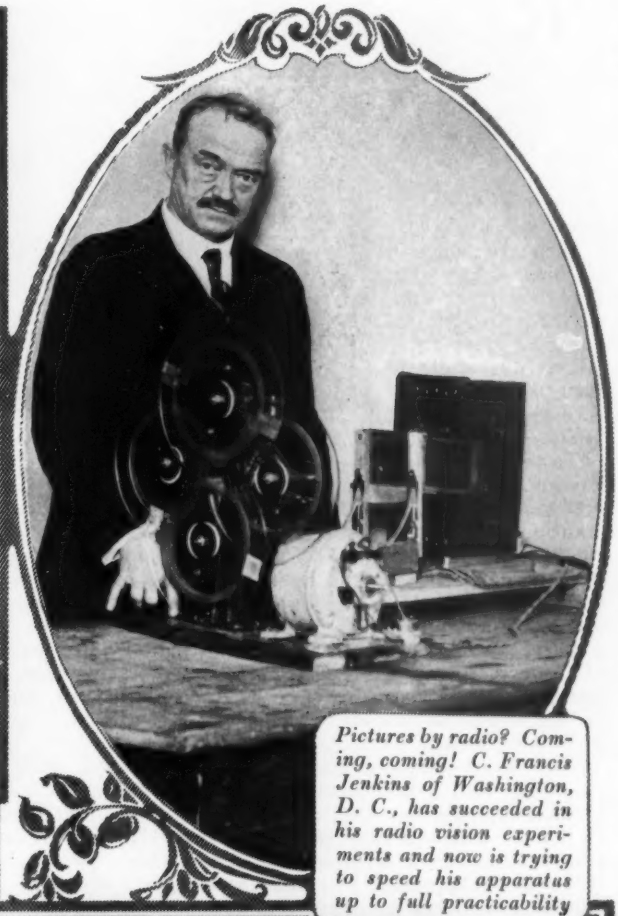
These three mechanical birdies sing by, for and to the radio, according to Bernays Johnson. As to how it is done—ah! just you ask him

This is positively the most remarkable picture ever taken of a New York subway car, because it is nearly empty and because J. C. Davidson is shown receiving broadcast programs underground

The natives at San Jose de las Lajas, Cuba, say "muchos gracias" when they listen to the programs from PWX at Havana, that being their way of expressing thanks in Spanish, their native tongue

Three Winks of the Camera's Eye at Radio

Two days after the editor had commissioned the artist to do the cover for this issue, Wesley Barry, movie actor, had this picture taken, proving again the charm of distance



Pictures by radio? Coming, coming! C. Francis Jenkins of Washington, D. C., has succeeded in his radio vision experiments and now is trying to speed his apparatus up to full practicability

If Richard Coeur de Lion had heard a radio set would he have looked like that? And Maid Marian made eyes at it? And Robin Hood listened or shot an arrow at it? Anyhow, this is how Wallace Beery, Enid Bennett and Doug. Fairbanks in those roles lined up before a loud speaker that evidently isn't as loud as it is big—let us hope so, anyway

Visiting in the Radio Home

"RADIO in the Home"—and in the office, on board ship, everywhere. There is hardly a place or business in which radio cannot fit, cannot be used with pleasure or profit, or both.

Such were the conclusions drawn by the thousands who visited the Radio Show in New York City. Of course their opinions were formed by the exhibits.

The latch string is always out for the world to enter by radio

Take the most striking, most highly individual and really significant space, that showing a luxurious home interior with the different types of Radiolas installed. There were Oriental rugs on the floor, two deep divans that 99 per cent. of the show visitors must have envied, tall graceful piano lamps, chairs and tables of distinction, a bench, a desk, a fireplace and mantel, two windows draped in lace and satin, and the background walls hung with fabric.

The visitors had one of two reactions on seeing this arrangement; one, of amazed appreciation; two, of feeling at home. Not everyone can live in such beauty, for it is expensive, but everyone can appreciate it, and realize that the instruments for which this setting was chosen must be of similar character, must represent perfection of accomplishment and appearance. Those who are accustomed to such surroundings found here, frequently, the first indication that radio was entering the home—their kind of home.

"I was amazed," said more than one visitor. "I had no idea at all that radio was so far developed." It pays to harmonize setting and product.

The day is gone when only the experienced amateur could enjoy radio. All can do so now, none more than the old-timer who finds many of his problems solved, certainly none more than the vast new body of radio enthusiasts who must take their apparatus into their living rooms, like the piano, the talking machine, the newspaper and the magazine, for all to enjoy. That is what this show exhibit impressed upon those who inspected it.

But that is not all there is to radio by any means. There is the business use of it, first on shipboard. So in another exhibit in the Grand Central Palace the Radio Corporation of America showed its modern ship transmitting and receiving apparatus.

Then there is the use of radio for trans-oceanic telegraphy, the creator of the larger part of the radio traffic of the present day. This traffic, as now is well known by professionals, is handled by automatic machines at high speed. The general public, however, still thinks of radio telegraphy as meaning an operator pounding a key while powerful sparks flash. So the RCA commercial exhibit featured a complete sending and receiving table, shown in operation in exactly the manner in which similar tables in the Broad Street office are worked 24 hours a day.

Messages were punched on a tape and fed through the automatic transmitter. That was sending. Messages were received on a tape, and transcribed on radio blanks by an operator. That was receiving. The fact that the "messages" were explanations of the method of operating did not lessen the interest of the general public, and the crowd at the railing was always four and five deep, while those at the railing struggled to carry away samples of the tapes, and the messages.

Another popular exhibit, and one that well repaid the many who studied it was that of the Radio Institute of America, which showed a group of historic radio apparatus, including a Marconi magnetic detector of the vintage of 1907, a spark gap dated 1902, a three-slide tuner of 1904, and a "pump handle" key. The old timers pored over these, and some conducted public debates among themselves as to when these things first became out of date. A display board illustrating each process in the manufacture of Radiotrons for receiving gave the modern touch to the exhibit, while specimens of the 10 and 50kw. water-cooled transmitting tubes were eyed reverently.

So it will be seen that this series of exhibits performed a double function of demonstrating the astounding progress made in radio for home, business and professional use.

Crowds thronged these exhibits at the New York Show, bearing away from the counter at the left a knowledge of high speed radio telegraphy, and from the exhibit at the right details of the historical development of the art

Arrested by Radio

Police Authorities in All Parts of the Country Increase Their Use of Broadcasting—New Agency Already Is a Factor in Crime Prevention

By Ward Seeley

Col. H. N. Schwartzkopf, N. J. State Police, broadcasts a warning

"IF there are any persons within the sound of my voice who contemplate the commission of crime they will do well to remember the radio, and, if Frank Carpenter of Ossining is listening in at this moment, tell Dot and Helen to heed my warning and watch their step, also Allen Meyers of Orange, N. J."

That is what William J. Burns, the famous detective, said on the radio telephone recently, when he broadcast through WEAF his appreciation of the service that radio is affording more and more effectively in the prevention of crime and the apprehension of criminals.

Most people think that the police, and especially detectives, must work in the dark. They picture a secret operative as a man who snoops around corners, hides in impossible places, and may look like an old woman one moment and assume the disguise of a man about town the next. If they ever really saw a detective acting the way they do in novels and on the stage they would call the police. Probably even a crook would.

Now it is a fact that often a great deal of investigation must be done quietly—call it secretly if you will—but it is also an important fact that the success of a criminal depends on even greater secrecy. Bring the offender out into the light so all may take a look at him, explain his methods of working, and the blinding glare of publicity robs him of the sheltering darkness that is essential to him.

That is where the radio telephone broadcasting station fits into all the local and national systems of crime detection, punishment, and prevention.

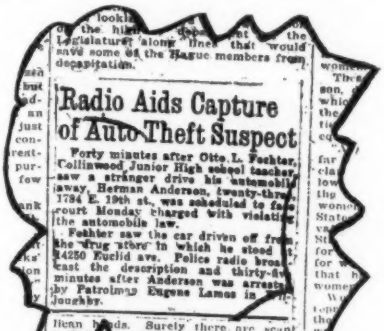
Mr. Burns gave a simple example during the course of the radio address from which the preceding quotation was taken.

"As an illustration in a small way tending to show the efficiency of the radio in apprehending persons wanted for crime," he said, "I desire to relate the following episode.

"In one of the larger middle western cities a short time ago a young man called on a large dealer in radio equipment and, in a plausible manner, stated that he had been authorized to purchase a radio outfit for a prominent public school. They delivered to him the radio equipment and, subsequently learned that he had obtained it fraudulently, as he did not represent the school. The matter was immediately placed in the hands of the William J. Burns International Detective Agency for investigation. They immediately broadcast the following message:

"Look out for a young man, 27 years of age; 5 feet 8½ inches tall; weighing about 150 pounds; florid complexion; blue eyes and light curly hair, with scar on the left cheek and a slight impediment in his speech; wearing a dark blue serge sack suit; tan shoes; and a light fedora hat. He fraudulently obtained a radio outfit.

"You can imagine the embarrassment and confusion of this young man as



Radio Aids Capture of Auto Theft Suspect

Forty minutes after Otto L. Fechter, Collinwood Junior High school teacher, saw a stranger drive his automobile away, Herman Anderson, twenty-three, 1784 E. 19th st., was scheduled to face court Monday charged with violating the automobile law.

Fechter saw the car driven off from the drug store in which he stood, 24250 Euclid ave. Police radio broadcast the description and thirty-five minutes after Anderson was arrested by Patrolmen Eugene Lamos and Joughby.

Only a stolen automobile—yet radio helped recover it and catch the thief, according to the Cleveland, O., "News"

he received this message while entertaining a group of friends with his new radio equipment. The following day his mother called and paid for the equipment."

Police departments all over the country are eagerly availing themselves of the advantages of radio, or seeking to do so. There is not a large city police force anywhere in the United States that either does not actually use radio in some way, or is not preparing to do so.

Directly, police use of radio divides itself into two main classifications. First, there is its utilization for purely police messages, service messages they might be called, in which the general public is not directly interested. Second, there is the use of the radio telegraph and telephone for broadcasting purposes, in order to give all who are listening such information as may enable them to cooperate with the guardians of the public peace.

In the first of these uses of radio the New York Police Department has been a leader, as it installed a radio telegraph transmitter at police headquarters in 1916, and has operated it continuously ever since, being the only transmitter in New York City that was not peremptorily shut down by the Government upon the declaration of war. This equipment operates with the police boat *John F. Hylan*, which has a powerful transmitter and receiver, and also with ships and land stations, both private and official, that may have traffic for the New York police. It has been of inestimable value in giving the police direct communication by radio in the thousands of cases that come up each year requiring the assistance of the police in marine work. KUVS, which is police headquarters, is liable to be heard almost any time of the day or night working with KUSM, the *John F. Hylan*, and also with ships along the coast and with coastal commercial stations and naval transmitters.

Hundreds of messages, most of them of an urgent character, zip through the air to and from this station. For instance, recently a steamer came into port with the captain, chief officer and wireless operator barricaded on the bridge with the wireless operator. An urgent appeal was sent to the New York police, stating that the crew had mutinied, and asking for assistance. A police boat met the steamer, an armed force took charge and the escape of the mutineers was prevented. It frequently happens that detectives returning from Europe with criminals in their custody send messages asking for police assistance at the dock to block any attempt at escape from the steamer. Without the

radio equipment at police headquarters, such messages would have to go through two or more hands before reaching the authorities and thus bring about a delay that might be fatal.

Prior to the installation of this radio equipment at headquarters and on the police boat, the latter had spent much of its time tied up to a dock where it was hooked up with a land telephone line so as to be in touch with head-

"Just a family scrap," is the report from the radio equipped patrol wagon, and Chief Mills of the Philadelphia police stops worrying about the riot call that came in five minutes before

quarters as much as possible. Activity was sacrificed for communication. Now, however, the boat cruises in the waters about New York steadily and is at all times in touch with the central office so that though it may be in the middle of New York Bay, instructions can be given it at any time that its presence is needed anywhere along the waterfront. As soon as a report of a fire, a catastrophe, a floating body or any other matter requiring police attention along the waterfront is received by the central bureau, it is transmitted through the air to the *John F. Hylan*. A great amount of time is saved in this manner, sometimes hours. So successful has been this work that the other police boats maintained by the city are being equipped with similar apparatus and in the near future the entire fleet will be in constant communication with headquarters and with each other.

It was due to the great success of this use of the radio telegraph for service messages, and because of the great promise of the radio telephone for broadcasting from the police directly to the people that so much emphasis was placed on radio during the convention of police chiefs held last fall in New York City.

Police Commissioner Enright of New York addressed the convention at length on the subject of radio, stating in substance that he considered it to be a most important adjunct to the police communication systems of the country, affording not only quick broadcasting of intelligence within the cities, but almost equally swift exchange of information from city to city. He urged that every chief on return to his office place great emphasis upon the development of radio equipment for his force. Since then there has been considerable activity in the larger cities, resulting in the appearance on the air of various police transmitters, including those in Chicago, Detroit and Philadelphia, while other towns have made arrangements whereby they have secured the cooperation of local professional and amateur operators.

Not only have local authorities interested themselves in radio, but the national government is developing extensive plans. The Bureau of Investigation of the Department of Justice has determined upon the installation of radio transmitting and receiving equipment which will be used in conjunction with its identification and information services. This Washington bureau is completing a gigantic file of descriptions, photographs and fingerprints of every known criminal, working in cooperation with every police department, sheriff and police officer throughout the country. This will serve as a single and complete source of information upon which all officials can draw in a minimum of time, whether by mail, wire or radio.

Mr. Burns is in charge of this new work, and says of it:

"This will be the most important step ever taken toward applying what is known as preventive measures. By that I mean, preventing crime and reducing it to the minimum. It will restrict the activities of criminals to such an extent they will hesitate to take a chance, and, if the courts throughout the country will do their part by making punishment for serious crimes swift and sure, it will undoubtedly reduce crime to the minimum and afford the most complete protection the people have ever had."

Patrolman Francis of the New York City Police broadcasts a general alarm

The second division into which police use of radio falls, namely, broadcasting to the public, is to be found in a number of examples all over the country, and though it is very new, nowhere being more than six months old, already great benefits have been derived. Most people do not realize it,

We operated originally a home-made 100-watt transmitter, which I am frank to say was not as efficient as a larger set, and with this in mind we installed in our new Police Headquarters one of the largest and most powerful stations in the country. However, with our small set we were able to accomplish several things, such as the recovery of stolen automobiles, and by the assistance of the Detroit "News," that has a large set, we were able to recover two lost children in Cleveland, Ohio.

W. L. POTTS,
Supt., Signal Bureau
Detroit Police Department.

This department has been using the radio daily for the past several months in the distribution of information throughout this state regarding lost or stolen automobiles. We find it a valuable instrument in carrying on the work of the department and up to the present time two stolen automobiles have been recovered as the result of information transmitted by us by radio.

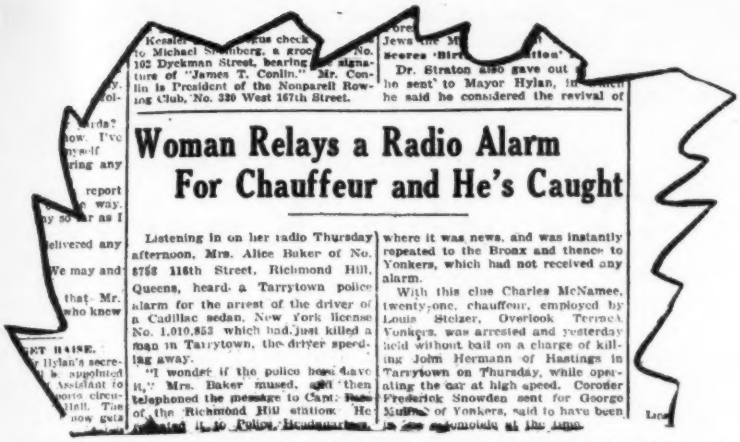
Needless to say, a police department to keep up with the time must avail itself of every instrumentality which tends toward progress. I know of no greater factor in the accomplishment of police work, especially in securing immediate cooperation between various police departments, than the radio.

D. J. O'BRIEN,
Chief of Police.
San Francisco, Cal.

The QRV Radio Co. of this city, broadcast station WGAB, is broadcasting police reports twice daily for this department. They are not making any charge to the Police Department for this service. However, we have not made any spectacular catches by radio so far, but have been notified by stations of great distances that they are receiving our Police Reports and are delivering them to the proper authorities. However, radio has been very instrumental in securing us some valuable information at various times.

Our Chief is very much in favor of radio being used in the apprehension of perpetrators of crime. It is the intention of this Department to install a large set at their earliest convenience to be used for Police work only.

G. J. LACY,
Supt., Bureau of Identification.
Houston, Texas.



Woman Relays a Radio Alarm For Chauffeur and He's Caught

Listening in on her radio Thursday afternoon, Mrs. Alice Baker of No. 8758 116th Street, Richmond Hill, Queens, heard a Tarrytown police alarm for the arrest of the driver of a Cadillac sedan, New York license No. 1,010,853 which had just killed a man in Tarrytown, the driver speeding away.

"I wonder if the police here have it," Mrs. Baker mused, and then telephoned the message to Capt. [illegible] of the Richmond Hill station. He where it was news, and was instantly repeated to the Bronx and thence to Yonkers, which had not received any alarm.

With this clue Charles McNamee, twenty-one, chauffeur, employed by Louis Steizer, Overlook Terrace, Yonkers, was arrested and yesterday held without bail on a charge of killing John Hermann of Hastings in Tarrytown on Thursday, while operating the car at high speed. Coroner Frederick Snowden sent for George [illegible] of Yonkers, said to have been

Another clipping that demonstrates radio's service to honest people. This is from the New York "World." Hardly a day passes that some newspaper does not record a new service of radio to the police

but every citizen is in effect a volunteer policeman, able to apprehend criminals wherever they may be found, whether in commission of a crime or fleeing from justice. It only remains to advise them of those cases in which they can be of assistance. Broadcasting a general alarm by radio telephone is proving more and more effective every day, and already numbers of stolen automobiles, missing people, and fleeing offenders have been recognized by citizens who either have acted directly themselves or enabled the nearest officer to do so.

New York is getting set to do broadcasting of this character on a large scale, having installed a 500-watt radio telephone transmitter which will operate on 400 meters as soon as the necessary requirements for a Class B broadcasting station have been met, and it will be on the air not only broadcasting warnings, but also lectures on educational subjects, classical songs and instrumental music, concerts by the Police Band of 90 members and by the Glee Club of 85 men, and similar popular programs. It will operate on a regular schedule, in cooperation with the other 400-meter broadcasters in the vicinity of New York. In addition, these stations have promised to "pipe down" temporarily at any time that the police need the air for an important announcement, so that at any time WLAW, as the New York police transmitter is called, will be able to go on the air with a broadcast emergency message. In the near future radio listeners are likely to hear something like this:

"We have just received a request from the New York Police Department for a few moments' time for the broadcasting of an emergency message. We will, therefore, sign off in order to give the police an opportunity to transmit. Station WEAF signing off for a few moments." "This is station WLAW, New York Police Department; the Atlantic and Pacific Bank at 14th Ave. and 8th St., was held up at 12.05 o'clock by three men, one a negro, who escaped with a large quantity of money in a Cadillac touring car, license number, New York 41144, and when last seen were driving north on 14th Ave. Watch all bridges and ferries. This is station WLAW signing off."

It is a remarkable tribute to the radio telephone that the New York Police should be intending to do this, for they have what is declared to be the most perfect wire telephone and telegraph system in the country. An important part of that network of telephone wires consists of a "tie-in" board by means of which it is possible to ring up every station house in the city and broadcast a general warning simultaneously to every precinct. In other words, the New York Police Department has a system of wire telephone broadcasting.

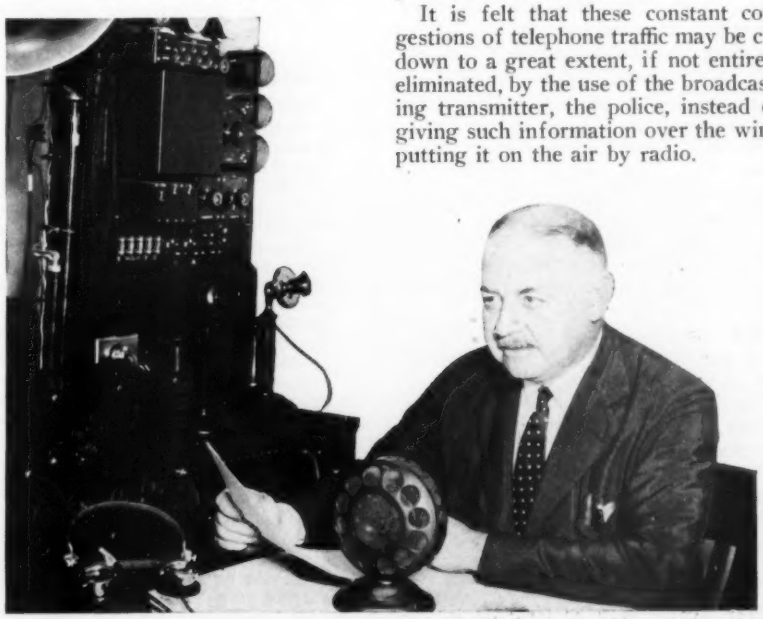
The addition of the radio telephone broadcasting apparatus to this highly developed system is being made in recognition of the great assistance that the general public is capable of rendering in time of emergencies.

Also, it affords a possibility of reaching certain elements of the Police Department which, at the present time, are not easily touched by "wire broadcasting," namely, the 161 police booths located along all the highways leading into New York and at important intersections. These booths are in charge of motorcycle police as well as of traffic officers, and have wire telephone connections with their station houses and also with the local exchanges of the New York Telephone Company.

It is planned to equip the booths with radio receiving apparatus, and thus eliminate the few moments' delay entailed by the present system.

Still another advantage of this broadcasting station is seen by the police and that is one that the average person would not dream of. When any great catastrophe occurs, or a rumor of a catastrophe is heard, and sometimes even when a big cloud of smoke is seen rising somewhere from the city, the telephone lines into police and fire headquarters become crowded and overburdened by people who telephone to ask: "Was anybody killed in the subway accident?" or "Where is the fire?" Although police headquarters has 104 telephone lines for the use of the general public, at times the wires become congested with the appeals of curiosity-seekers.

It is felt that these constant congestions of telephone traffic may be cut down to a great extent, if not entirely eliminated, by the use of the broadcasting transmitter, the police, instead of giving such information over the wire, putting it on the air by radio.



Fifth Deputy Police Commissioner Faurot, the famous investigator who has run down many skilled crooks, makes the first speech over the New York City Police broadcasting station, an installation which he expects will aid his work greatly

Dorothy Knapp

"RADIO setting-up exercises, radio stimulation of the imagination, radio songs and dances, all help us cultivate our natural beauty."

Experience of a Famous Beauty

Dorothy Knapp

As Told to Paul S. Gautier

"BY the way," said the editor to us one day. "I'd like to have you run up to see Miss Dorothy Knapp and get a good interview. She's the one, you know, who won the first prize in the professional beauty contest at Atlantic City, and I understand she is a radio fan."

"Certainly," we replied, "that sounds as though it might be a pleasant task—to say the least—and not difficult."

"Yes, undoubtedly," he said, "but keep your mind on radio."

"That," we ventured, "may not be so easy."

We met Miss Knapp in the lobby of the fashionable Hôtel des Artistes, in West Sixty-seventh street, New York. She had just been posing for a magazine cover for Howard Chandler Christy, than whom there is no whomer, and we immediately realized that those pretty faces one sees on magazine covers are not creations of the imagination.

We had "met" Miss Knapp many times, full face and in profile. So have you. And to sit down to luncheon with the most beautiful girl in America, a living magazine cover, and talk about RADIO—well, it's too much. It's torturing a magazine writer, that's what it is.

We complained about it, and thereupon we discovered that she possesses tact as well as beauty.

"Let's talk about both radio and beauty," she said, "and strike a compromise.

"As a matter of fact," she went on smilingly, "the two have a definite relationship now. By that I mean radio may be directed to serve beauty, to help it. That's what attracted me to it."

Her words were as pleasing to listen to, as her face was to watch. They came without effort. She seemed to be thinking aloud. Her diction was clear and concise. The intonation of her voice was low, and yet it floated across the table in the musical notes of a babbling brook.

"How is that?" we asked, referring to her last remark.

"I chanced to listen in for the first time when a phonograph record 'setting-up' exercise was being broadcast," she replied. "The novelty of it struck me. I always had exercised a few minutes after getting up in the morning, but many times it was an effort and took considerable will-power. Coming over the radio, the music sounded so enticing it fairly compelled you to get into its spirit, and the daily task of exercising, instead of being work, became play and something to look forward to.

"Beauty that is only skin-deep, as they say, is not beauty to be sought after. Real beauty—and please don't put me down as admitting I am beautiful, for I am simply accepting the judgment of the world—means you not only have a pretty face, clear complexion, straight features, the proper proportions and all that, but it also implies you know how to bring out that beauty which is everybody's natural gift, if they only knew it.

"Eyes which apparently may lack beauty, will just sparkle with it if the mind thinks beautiful thoughts. That is not explaining it very well. Did you ever see a girl's eyes after she has just come from a horse-back ride? Did you notice how really beautiful they were, how they sparkled with the joy of living?

"Radio music can be music with which to exercise, to dance, to sing. And any exercise produces natural beauty. That's how radio can help.

"There is another side of it. By stimulating the mind, the imagination, it is possible often to bring out hidden beauty. I help mother about the house, ironing, sewing and doing the hundred and one little odd-and-end things there are to do. Most girls think this work is drudgery, and they hate it, so how can they be beautiful if they have hate in their hearts? Housework may be made interesting simply by having a radio handy to fill your mind with music and the other entertainment that comes over. Radio is simply wonderful for women.

"It carries you away, increases your interest in life—and thus produces beauty."

The girl loves outdoor exercise. This is probably her greatest recipe for physical beauty and fitness. "Keeping trim," she calls it, and every minute she can spare from her work finds her outdoors either riding a horse, or playing golf or tennis or doing something with all her heart and mind and body.

Miss Knapp has an ambition. She wants to go on the stage, and for months she has been preparing herself for it. As she has not decided whether to take to the speaking or silent drama, she has been preparing for both. Soon, she says, she will make her decision, and whether it is the movies or the legitimate stage, theater-goers are certain to see a really beautiful girl—one who not only is beautiful physically, but one whose thoughts are serious, and whose aim to do useful work in this world is beautiful, too.

Beauty From Within

What is Beauty?

"Beauty is only skin deep," is a saying so ancient that it has become a proverb, yet like many another phrase, its acceptance is more general than its truth warrants.

Beauty starts far, far within. Who has not heard it said of one that "she has a beautiful disposition," and who has not seen the beauty of the disposition reflected in the appearance of the person concerned?

Love and happiness in the mind and heart can beautify features that otherwise would be plain; and hate, envy, jealousy and unhappiness will surely bring ugliness to rest upon the countenance, however fair, of her who thinks such thoughts.

And so it is that radio, by increasing the happiness of mankind, can be said to be beautifying the race.

English receivers must bear this mark

"This Is Station 2LO, London"

Britishers Listen Eagerly to Their Own Broadcast Programs—Receivers Must Be Licensed—Description of Marconi House Transmitter and Its Achievements

BROADCASTING has begun in England, where four stations now are in operation. The public is listening with keen interest, and all reports from England show that our British cousins are going through just the same period of excitement over the new science that America experienced over a year ago. One of the stations is located in London, in Marconi House. Its call is 2LO, and it has a transmitter with 1½ kilowatts power, much above the American average of ½ kilowatt. It has been heard in all parts of the British Isles, and as its power is considerable, it is considered likely that sooner or later experienced amateurs with sensitive receivers will succeed in hearing it in this country.

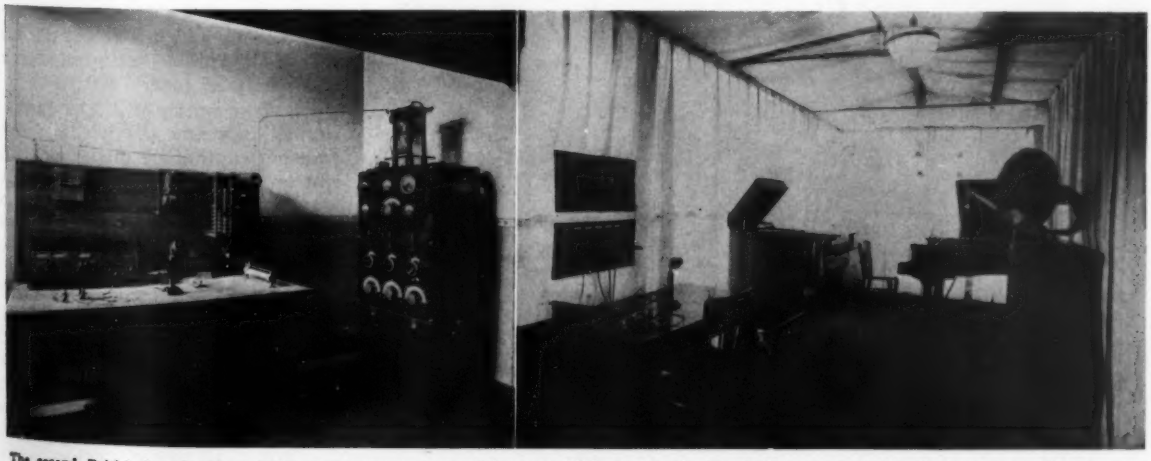
Another station is in Manchester, and is known as 2ZY. It has 800 watts power, but expects to increase this to the maximum allowed of 1,500 watts. This leaves four other broadcasting stations to be erected, eight being the limit imposed by the present British regulations. 2LO operates on 360 meters, 2ZY on 385 meters. The two other stations are 5IT, Birmingham, 425 meters, and 5NO, Newcastle, 400 meters. By varying the wave length, the English permit selective tuners to eliminate "jamming."

The British broadcasting station 2LO has transmitted programs on which have appeared many of the leading artists and performers now in London, including instrumentalists, singers and entertainers of all kinds, while prominent men in many lines of endeavor have spoken over the radio to their English listeners. The programs are being presented under the direction of Mr. Burroughs, with the assistance of Capt. Lewis and of Mr. Stanton Jefferies, who is musical director of the company.

The station also organized its own "wireless orchestra," consisting of violin, viola, cello, clarinet, oboe, and piano. This orchestra has been a subject of much experimentation. In the first place the radio operators had no experience to guide them in the placing of microphones, and after trials of many arrangements they hit upon a method of using three of these pick-up devices, hung at different levels, and each pointing in a different direction, so as to cover about every point of the compass. Also there had to be considerable testing done with the various instruments and combinations of them, in order to discover the tonal qualities that transmitted best. The result, as is testified by English listeners, has been eminently successful, and the General Post Office is doing a land-office business in the issuing of licenses for receiving purposes. As has been told in these pages previously, the British broadcasting plan entails the licensing not only of transmitting apparatus, as in this country, but also of receivers. The fee for the receiving license is set at 10 shillings, which at the normal rate of exchange is about $2.45. This is an annual fee, and heavy penalties are prescribed for the use of a receiving station without this license. All apparatus, whether complete sets or not, and including amplifiers, head sets, loud speakers and vacuum tubes, must bear the mark of approval of the Postmaster General, which consists of the stamp containing the letters BBC in a circle, and around the rim the words "Type Approved by Postmaster General."

Regeneration, or "reaction" as it is known in England, is forbidden if it is capable of causing interference with other stations. This is in order to prevent the filling of the air with the squeals that are heard in congested districts in the United States, where many regenerative receivers at times cause their tubes to oscillate, producing a howling sound. The British regulation reads: "Valves must not be so connected as to be capable of causing the aerial to oscillate." While at first it would seem that this effectively prohibits regeneration, as a matter of fact it does not do so, as there are regenerative circuits which secure nearly all the remarkable advantages of regeneration without being able to re-radiate a wave from the receiving tube.

Another British regulation requires that aerial wires must not exceed 100 feet in their combined height and length. Americans who endeavor to erect an antenna as long and as high as possible may think that this entails a hardship on their British cousins, but as a matter of fact engineers are agreed that for waves in the vicinity of 360 and 400 meters a comparatively short antenna, about 80 feet in length and not over 20 feet in height, is more efficient on the average receiver than a longer and higher wire. Presumably



The second British broadcasting station to commence transmitting was 2ZY, at Manchester, feeding a district hardly less congested than that around London. The views above show the Manchester operating room and studio

the English Post Office by height means distance from the wire to the nearest grounded object, a roof, for instance.

Not only have programs been broadcast direct from the studio of 2LO, but also the operas produced by the famous Covent Garden Theater, in London, have been transmitted through the air with great success. This came about through the energy and enterprise of W. J. Crampton, consulting engineer to the Royal Opera House, who realized that if some form of agreement could be arrived at between the Opera Company and the British Broadcasting Company, the public would materially benefit by enjoying at home the services of the artists and orchestra connected with the opera. He, therefore, approached the executives of the two organizations, and his proposition met with an enthusiastic response.

The opera stage is located some 400 yards from the broadcasting studio and in that respect the station considered itself to be fortunate, as the proximity of the performances meant that no extensive wire circuits with their attendant liability to noise, would have to be employed. Once negotiations had been completed for the broadcasting of performances the General Post Office was called upon for aid, and a lead-covered multiple telephone cable was quickly run through the existing telephone conduits that form a network under the city. The shortest route, of course, was selected.

One pair of wires in this cable is employed for telephones so that the engineering personnel at the opera may communicate direct with the studio by voice without their words going out on the air. In this manner the operator at the station is able to keep in constant touch with affairs on the stage, where the control engineer, who has a position on the "prompt side" of the stage, is provided with a telephone instrument that is connected not only with the studio, but also with another group of engineers, operating the voice amplifying equipment. The latter is installed in the basement of the theater. This excellent arrangement of intercommunicating telephones maintains direct communication among all those responsible for the broadcasting of the performances.

BROADCAST LICENCE.

A 41602

WIRELESS TELEGRAPHY ACT, 1904.

Licence to establish a wireless receiving station.

Means The Wirelessworld & Radio Review

of 12/13 Henrietta St. London W.C. 2 is hereby

authorised (subject in all respects to the conditions set forth in the Schedule hereto) to establish a wireless station for the purpose of receiving messages at the address

APPARATUS USED UNDER THIS LICENCE MUST BE MARKED

for a period ending on the 30th day of November next.

The payment of the fee of ten shillings is hereby acknowledged.

Dated 30th day of November 1922

Issued on behalf of the Postmaster-General

W. H. [illegible]

Secretary.

Signature of Licensee WIRELESS WORLD & RADIO REVIEW.

If it is desired to continue to maintain the station after the date mentioned in this Licence must be taken out within fourteen days. Heavy penalties are prescribed by the Wireless Telegraphy Act 1904, on conviction of the offence of establishing a wireless station without the Postmaster-General's Licence.

2801 G&S 194

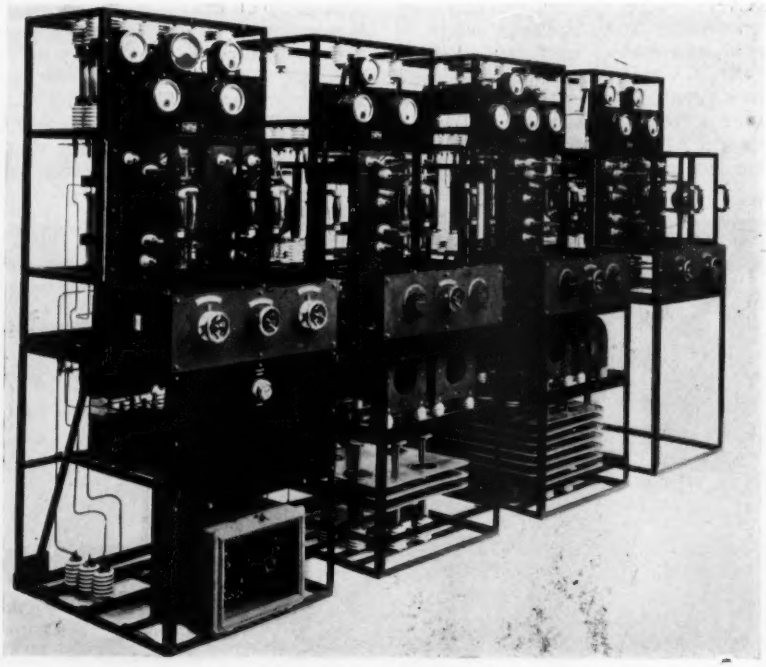
APPROVED BY POSTMASTER GENERAL 2BC

Stamping Office. BEDFORD ST. STRAND. W.C. 2 3 NO 22

It costs ten shillings, or about $2.35 and it's just a license to use a receiving set for a year in England, with strict rules and regulations to be observed. Part of the fee goes to support the broadcasting that the licensee hears

Reports from England to date show that so far a single Western Electric microphone is used to pick up the opera, and that this is located on the stage near the footlights. The wire from this microphone runs through a triple cable to the voice amplifier in the basement, which gives three stages of power amplification to the currents before they pass into the broadcasting wires in the special cable to the studio. In the studio this cable is connected to the amplifying transformer that is used there when programs are being transmitted from that room, and from that place the operas go through the regular circuit to the transmitter. Reports have been received that these operas have been heard in Edinburgh to the north, and in Paris to the south, with good volume and great clearness and purity of tone.

The transmitter at 2LO is in design similar to many of the broadcasting transmitters that are giving such excellent service in the United States. Electrical power is derived from the London Electric Supply Company's mains, at 200 volts direct current, and there is also a connection whereby current can be taken from the special London theater supply main in case of difficulty with the usual source. From the studio room the current goes to a 10-horsepower direct current motor which is directly coupled to a 6-kilowatt single phase 300-cycle generator, supplying 500 volts A. C. This provides ample margin for any increased power



2LO's electrical tongue is here—the Marconi radio telephone transmitter that is heard in a wide radius around London. The equipment at 2ZY, Manchester, is similar

Mr. Stanley Jefferies, who wields the baton above, experimented a great deal at 2LO until he found just the right combination of instruments and microphones that gave the best results by radio. Then this picture of the Wireless Orchestra was taken

which may be authorized by the Government later. At present, only 1½ kw. is supplied to the oscillator tube. Two complete motor-generator sets are provided, with a throw-over switch so that if one should get out of order the other one could be quickly put in use. In fact, throughout the installation duplicate equipment has been provided as far as is possible in order to assure continuation of operation and prevent idleness due to breakdowns. The power room is situated at a considerable distance from the operating room, and is controlled entirely from that room at the top of the building.

Current from the motor-generator goes direct from the power room to the operating room where it is supplied to the primary of a 6 kw. transformer. Here again, a duplicate instrument is installed for emergency use. The output from a secondary of this transformer is at 22,500 volts. This high voltage is taken to the rectifying apparatus, which is of the kenotron type, using two tubes in a full wave circuit, with which both halves of the cycle are rectified into direct current at about 10,000 volts.

The result is that the output from the rectifier consists of direct current with, however, a ripple of 600 pulsations a second. If this were applied direct to the oscillating tube there would be a very strong and objectionable hum sent out on the air, so the current is put through an elaborate filter system, consisting of a condenser group, an iron core choke coil of large size, and another condenser group of the same capacity as the first. After leaving this filter system the current is, to all intents and purposes, perfectly smooth and is in fact, much smoother than the current from a D. C. generator, which no matter how perfect it may be, always has some irregularities due to the commutator and sparking from the brushes.

The transmitter set proper consists of the usual arrangement of amplifier, modulator and oscillator tubes.

The aerial of 2LO consists of two cages, each of which has four wires, stretched between two masts, which are about 50 feet above the roof. The cages are about 100 feet long. The roof of the building is covered with lead plates and these, together with the steel framework and the lightning conductors, are bonded together to form a common ground for the transmitter.

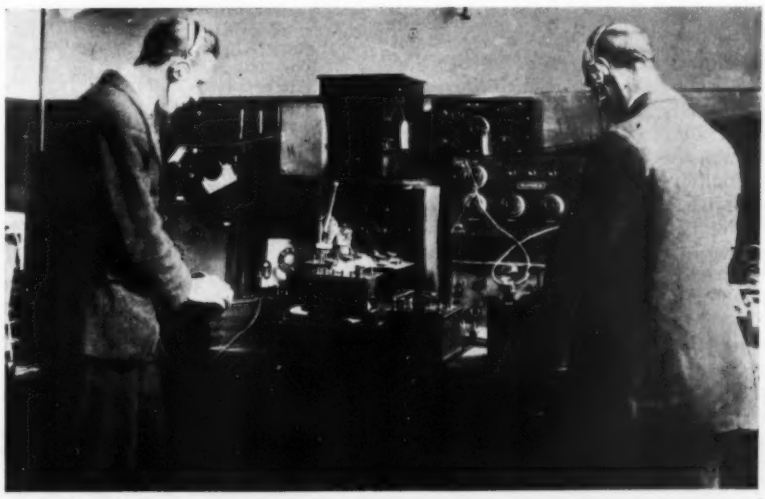
The studio has received special attention, both from the viewpoint of appearance and from acoustic quality, and although the experts consider that the latter is not as perfect as it might be, nevertheless the results obtained are considered excellent. In accordance with the American practice, echoes have been excluded as much as possible by hanging thick curtains at some distance from the walls and placing a heavy carpet on the floor

In addition to the special wire for the opera performances, there is also a private line direct to Reuters, the famous European news agency, so that the latest information may be received for transmission without delay. It is also planned to run a line direct to the Greenwich Observatory, the astronomical observatory that determines Greenwich Mean Time, so that time signals may be transmitted direct from the apparatus there.

Brazilian Station Heard?

WHAT may be the first instance of Latin-American broadcasting having been heard in the United States has been reported by Arthur E. Osmun, of Newark, N. J. He states that on January 7 at 12.30 a. m. he heard a voice calling KDKA in broken English, sending greetings to Stefanssen, the Arctic explorer, and signing off indistinctly as SPR or PRE.

This station probably was SPC, the broadcasting station at Rio de Janeiro, established for demonstration purposes during the Brazilian Exposition. It operates on 450 meters, and transmits a special test every Saturday night at midnight, Eastern standard time. If advices from Rio confirm the transmission reported by Mr. Osmun he will be the first to have heard this station in the United States.



This is what is back of the "approved" stamp of the English post office. Officials of the General Post Office put receiving sets through rigorous tests before approving them. Of course, not every set is so tested; the maker submits one instrument of every type, and if it passes the examination, the approved stamp goes on all its brothers

How Intelligent Youth Portrays Pitiful Age

Mary Alden

Famous Character Actress for the Films Tells Maurice Henle How Head and Heart Combine for Success

THREE-FOURTHS of the English-speaking world have come to love Mary Alden on the screen. Only once (and then she stepped abruptly from her usual type of character portrayal), did her acting make the public bristle with hatred—and then she wanted it so, with the result that the public more than made up in its admiration of her acting for its hatred of the part she played. This was, of course, when she played the part of the mulatto mistress in "The Birth of a Nation."

"I hated that character," Mary says earnestly, "I wanted everyone to hate her."

It was different, however, in "The Old Nest." Do you remember the mother in that picture? Do you recall how she gained the instant sympathy of the country, how she melted the people's hearts, and did the almost impossible—made the movie audience cry?

That mother was Mary Alden, and her brilliant accomplishments not only account for the fact that she ranks today with the very best in her profession, but also indicate why radio, in its search for famous artists, called on her to broadcast.

Several months ago Miss Alden spoke over the radio from WJZ. She was glad of the opportunity of reaching so many thousands of persons, and in her short talk she answered many questions on motion picture subjects, questions that are uppermost in the minds of that large section of the public that craves to act for the silent drama.

The advice she gave over the radio telephone is typical of the woman.

"If you are sincere, if you really want to succeed in pictures," was the substance of her remarks, "you must prepare by study, just as you must plan for success in any other business or profession. The motion picture industry is the wrong place for those who have failed in all other pursuits. At least a spark of genius, a great deal of ability, and a capacity for hard work are the three essentials."

The interesting thing about Miss Alden's work is that few of the public know how she really looks. In most of her pictures she has played rôles where the make-up absolutely concealed her identity. Many of these characterizations have been "mother parts," as in the case of "The Old Nest."

Miss Alden is young. The many who heard her broadcast surmised it from the vibrant youthfulness of her voice, and many were surprised, having expected to hear speech that was in keeping with her screen characters. It was when she was but twenty-two years old—what a short time ago that was—that she was cast for a picture in which she had to take the part of the mother of Lillian Gish. She made good, and right then she began to receive letters from her admiring public, starting: "Dear Little Mother . . ."

The photographs reproduced with this article will reveal the youth and womanly beauty of the star. They will come as a revelation to the many who think of her only as a sad-faced, gray-haired mother, and who would hardly believe that the voice over the radio was really that of Mary Alden.

Mary Alden has three loves—
The first is her art.
The second is children.
The third is the companionship of decent people of high ideals, who put their philosophy into practice in their daily lives.

It is not surprising. Most of her screen portrayals have not revealed her youthful beauty, but in them nevertheless she has been able to portray her own character beneath the gray wigs and penciled wrinkles that mean old age to the camera.

She has been chosen nearly always for the "good" types. It is more difficult to do those, she says. Vampire rôles only necessitate a physical appeal, and that is easy. But there is another reason why the movie directors pick her for the "good" parts, though she will not admit it.

It is because she is just of that type herself, and that is what the screen needs.

"My mother died when I was only four years old," she said over the luncheon table. "It was because I have always missed her that I was able to put so much into the mother parts, I suppose."

Miss Alden is of the type that studies constantly. She is always anxious to learn new things, seeking the "why" of everything that comes to her attention. So she has a vast fund of varied information and talks charmingly on many subjects. We entered the grill of the Ansonia Hotel, New York, where she lives, about noon. We were the first to enter. It was about three that we left—the last to go. It wasn't a one-sided interview, but a conversation.

Space does not permit a review of the many topics discussed. We soon strayed from radio to metaphysics, and then I learned that even in science Miss Alden constantly seeks for the truth, ever studying, attending church, discussing, anxious to learn more and more.

As to radio, she believes it is a power for good, at least that it is so intended to be.

"It impresses you simultaneously with man's power and with his smallness," she said. "To think of being able to harness this immense, invisible force, for that is what it is, awes you.

"I hope it will mean the coming of the time when we will have a universal language. Let radio destroy the Tower of Babel, that is holding men apart, making them suspicious of one another. That's what we need in this world — understanding. Most good people are alike, no matter what religion or nationality they have. Let's stop all this fighting, jealousy, hatred, and live together enjoying the good that is in life. Radio will help—I am sure."

Miss Alden has been acting steadily in pictures. She "worked," as the trade expression goes, in eight of them during 1922. Her home is in Los Angeles, though she has been living in New York for the past fourteen or fifteen months.

"WHAT a wonderful audience when we sing by radio! We ought to be grateful to the men of science who have made dreams come true"

An Interview With

Rosa Ponselle

(Metropolitan Opera Star)

By Claire Burquo

Rosa Ponselle

"IT always used to affect me, the preliminary trials in making a phonograph record," said Rosa Ponselle, "but now that I have sung several times for the radio I march right up to the horn in the phonograph laboratory without a quiver! I used to feel almost as if a part of me, instead of just my voice, was being 'canned' as they call it—brrr! How would you like to be canned, eh? all sealed up tight in some nasty tin waiting for someone to stick a knife into you and let the air out! Brrr-rr!

"But radio, oh, that's different. I like to sing for people, people like to hear me, and so, and so—well, you see how it is. I sing for the radio and I know that all over there are thousands and thousands of people listening to Rosa. She is not so very big, what, in all this great big space that she sings into by radio? No, it makes her feel teeny weeny. She loses the 'big head' and gets a great big heart.

"I like to think of my audience as I sing for the radio. I think of the wealthy man with all the latest things he can buy to make my voice sound beautiful, and then I think of those with things not quite so expensive but still very good, and then 'way 'way down is the youngster with the home-made receiver. I wonder to whom I sing best? I do not know, I give my best to them all. To the lonesome chap in the hall bedroom, the farmer, the business man, the hospital, the ship, everywhere.

"What a wonderful audience, just wonderful! I can't see them or hear them, but when I am through I think I can hear them saying, 'Thank you, Rosa.'

"It is such a wonderful thing, isn't it? Yet even already, when it is still all so new and wonderful, everybody seems to take it as a matter of course. Do you know, we all accept the wonders of science too much for granted?

"I am an artist, perhaps that's why I marvel at what science has done. We travel by train and boat, and we fly in the air; we use the telephone and the telegraph; and now the radio; and we never think of the struggles that all the inventors had to make these things for us, we never think what a wonderful age it is, what magic we perform daily with steam and gasoline and electricity. We never stop to thank people like Mr. Bell who invented the telephone or Mr. Edison who invented the electric light; no, we only curse some little miserable company somewhere if something goes wrong only for a minute. Bah!

"People work miracles daily, until new ones hardly get any attention at all. Why, it's gotten so that the phrase 'Nine days' wonder' is the height of fame. Nine days! We ought to be marveling the rest of our lives, we who live in this wonderful time.

"And we ought to be grateful for the rest of our lives, too, to the men of science who have made so many dreams come true, often at the cost of years of hard toil, sometimes of life itself. The newspapers print on their front pages columns about the escapades of movie people, and stick way in the back somewhere an inch or two about a medical man entering a chamber of deadly gas, risking death in order to find out a little more in the hunt for safety for us all. You ask such a man if he doesn't run great danger and he smiles and says that 'it's all in the day's work.'

"What a Utopia our world would be if everybody could get some of the scientist's spirit, and work together for the advancement and betterment of every evil condition. Radio is just one of the things that the scientific spirit has brought us.

"Some people think that the world needs more art, more artists. Well, I am an artist, and I tell you it is not art that America needs, but the heart and mind and soul and vision of the scientist."

Miss Ponselle's coach had entered, and was seated at the piano, waiting.

"Now, I must practice, and you will excuse me, I know, for we artists have to work just as scientists do. Good-by, and you will write what I have told you about science?"

It is written.

And there is more to be told, for Rosa Ponselle, Metropolitan Opera star, should never appear in print without her biography. Her story begins in Meriden, Conn., where she was born in a poor, hard working Italian immigrant family. She early learned how want pinched, and how big the dollar was. And she early learned to sing. It just "came natural." Only a few years ago she was singing in a movie house in Meriden, her first job, for twelve dollars a week. Then a hotel in New Haven engaged her. Strangely enough, the Yale students allowed a Broadway cabaret to deprive them of her. After a brief engagement on Broadway she and her sister Carmela were secured for the Keith vaudeville circuit. They sang under the family name as the Ponzillo Sisters, and thought that they had reached the pinnacle of success, until a voice teacher, dropping into the Riverside Theater in New York, heard Rosa sing and induced her to give up vaudeville for a chance at grand opera.

Eight months later she made her first appearance on the stage of the Metropolitan Opera House in one of the most brilliant débuts that old house ever has witnessed. She has been singing there for five years, ever since her twenty-first birthday.

She has been broadcast in Kansas City, Evansville, and New York City. Her third radio audience heard it said that "Italy gave her her voice, America her opportunity."

And Rosa herself seized it by working hard when the great chance came, for be it known that with even the greatest opportunities and most brilliant natural gifts, success must be hard-won.

There are scores of good voices, many of them as good as Rosa's. Any New York music critic can name you several. But they will never get to the top because their possessors will not pay the price in effort.

The effort must be made. It consists of tedious practice, practice and more practice. And then, for opera, what is usually the hardest of all—learning the parts. Do you wonder how the singers manage to get through a long and intricate opera without notes? Ah, they have put in many weary hours learning the whole performance by heart!

Thomas Lipton

"ENGLAND must speed up, so that she and America may speak to each other freely and catch each other's spirit by radio"

Says the Famous Sportsman

Sir Thomas Lipton

Himself an Ardent Radio Fan

An Interview by T. J. Dunham

TRANS-ATLANTIC broadcasting now is an established fact—that is, several American stations have been heard clearly in old London town across the ocean. Time and progress are making it a daily routine.

But in rejoicing over the fact that contact has been established with Europe by the radio telephone, one should not lose sight of one of England's leading citizens who participated in an early attempt to broadcast across the ocean—and failed. That man is Sir Thomas Lipton, merchant prince of England and one of the most noted figures in the international sporting world, especially in the field of yachting.

Sir Thomas is now in London. A few months ago he was over here and it was then that he made the effort to be heard at home. It is most to be regretted that he did not share in the glory of accomplishment that rewarded others only a short time after—as time is reckoned, but an instant later.

It was midnight in the studio of WOR and everybody was excited at the prospect of transmitting the voice of their distinguished guest across the ocean to his home. British and American flags gave the studio a holiday appearance.

Lipton appeared, a few musical selections were played in order to give the English listeners a chance to tune in. Then he spoke into the microphone—or as he called it, "that ghastly thing."

But his voice did not go over. The power and quality of the station that night brought forth many appreciative letters from American radio fans, but England did not pick up WOR's wave. When Lipton was told this, he said he would "try again," on another night.

This he did a few days later, but again he failed. Shortly afterward word came from England that another station had been heard there, and Sir Thomas again proved his thorough sportsmanship by his unreserved enthusiasm over the accomplishment. Today, when it is a nightly affair, England has no more enthusiastic radio fan than this man who early tried to do what others succeeded in accomplishing.

He has several radio sets on his great estate in England, and he has occasionally caught snatches of American broadcasting. His ambition is to have one of the best sets in the British Isles, and that he will have in the near future.

Reception from America interests him not only as a stunt, not only because he likes this country, but because he has many important business interests here. He is a close student of American affairs, and keeps careful control of his business on this side of the water. No man in England, probably, is more sympathetic with American ideals, or better acquainted with American principles, practices and possibilities.

His admiration for the progressiveness of the Americans is frank. He admires most their "go-ahead" spirit as it is being shown by the onward march of radio progress.

"How typical of our American cousins," he said when shown the broadcasting studios over here. "We must catch up with you.

"Radio will play a part in the next international yacht race, if I have anything to do with it. I for one will give my yacht the very best equipment, and the progress of the race unquestionably will be a new feature and a good one for the American broadcasting station. Imagine being on a contesting yacht, and hearing broadcast results of the race while sailing in it!"

Sir Thomas displays considerable interest in the possibility of transmitting power by radio. He does not attempt to make any prophecy, but hopes the time will come when power can be thus sent through the air. Maybe then he would stage races with radio-driven motorboats.

He is one of the world's richest men, and the story of his fortune is the old one, more typical probably of Americans than Britishers. He started as a poor boy.

"When I was a boy my one ambition was to make enough money to buy my mother a carriage," he says.

"And before she died she could have had fifty of them had she so wished."

Sir Thomas is a bachelor, and his mother's and father's pictures always accompany him on his travels—his home and heart are with them and where he goes they go also. He is a great traveler and there are few places in this old world that Lipton has not visited, though none more frequently than America.

Lipton always has been impressed with American "night-life."

"Why, the lassies in London don't stay up all night the way they do here," he said while over in this country the last time.

"I don't think it's good for them, do you? But you've fine lassies mind, ay! fine lassies."

His rich brogue accentuates his words, and delights his hearers.

"I was amazed to find radio developed to the point it is," he said on his recent visit to America. "England must speed up, so that the time will come when the two nations may speak to each other freely, hear each other's concerts, and catch each other's spirit."

That is his dream—the time when America and Britain will be linked not only by the ties of a common language, not only by blood ties, but also by what he characterizes the strongest of them all, the tie of free and uninterrupted communication through the interchange of broadcast programs.

Now that broadcasting is under way in England, and energetically, too, and now that he is back home, it may be expected that he will try for the third time to project his voice across the Atlantic, but in the reverse direction. In fact, as this is written plans are being made on both sides of the water for a special test of the English transmitters. As it would entail silence for a time on this side of the water, it is difficult to arrange. But it may be done in time, and then England will be heard here.

Then, thinks Sir Thomas, we will be closer together than ever—Americans and Britishers—and no force could be strong enough to break down the friendship doubly cemented by broadcasting.

Cuba Leads the Way in International Broadcasting With

PWX

Which Speaks from Havana to Both Cuba and the United States

Paul Falcon, PWX announcer, trying to teach jazz to Rene Rocabruno

"HAVE you heard Havana?" For the past five months this question has been frequently asked of and by broadcasting listeners in the United States. Many times the answer has been "yes." And in the instances where such an affirmative answer was impossible, the question served only to stimulate a desire to hear regularly the first real, practical international broadcasting.

The reception of PWX, the broadcasting station of the Cuban Telephone Company at Havana, Cuba, by listeners in America is, of course, only the shadow cast before by the greater international broadcasting that is to come.

Cuba is close to the United States, it fairly snuggles to our shores; but there is a language barrier nevertheless. The ease with which those responsible for the success of PWX solved the language question points to the time when reception from the Continent, from South America and possibly even from Japan and China will be common.

It was during last October that the station first was heard on the air. Since then it has found for itself two definite and distinct functions. It serves to amuse and educate those on the island of Cuba. But it also is intended to—well, call it educate if you will—the great American public upon which the Cubans rely so heavily.

Spanish is the prevailing language in Cuba and to entertain the home folks it is necessary, naturally, to broadcast the programs in that language. But while a fairly large number of Americans understand Spanish, still in order to get the "message of Cuba" over to the American public it was not possible, the officials down there saw, to rely solely upon the mother tongue.

"When in Rome, do as the Romans do" is an old proverb. And when you want the Americans to sympathize with you tell them your story in their own language was the way the Cubans argued. And so part of the programs put out from PWX are in Spanish and part—that intended for the ears of Americans—in English.

Of course those in the United States are able to hear the Spanish programs as easily as the English ones. The ether is no respecter of language. And as the result of this it is safe to say that this reception of programs in Spanish has done more to stimulate the desire to understand the language than anything else ever has or ever can. The natural desire to understand is one that insists on being satisfied and many Americans within the range of PWX, persons of all ages, are devoting their every spare hour to the study of Spanish.

Few, if any, radio receiving sets are in operation on the island of Cuba, outside of the city of Havana, and those persons within the metropolis of Cuba have demonstrated that the type of musical program that they want must be composed entirely of classical selections. Jazz for some reason or other does not get a ready ear. Those who have been in Cuba and talked with its citizens, believe that this is because most of the receiving sets are owned by the upper class Cubans. There is no middle class, and the natives are too poor to buy.

There are few sugar or tobacco plantations not equipped with radio. And the owners of these plantations are, as Americans know, wealthy and well traveled men. Very few receiving sets are manufactured in Cuba, although it is interesting to note that the mahogany used in the manufacture of many American-made sets is grown on the island.

PWX operates each night from 8.30 to 10 o'clock. Many big events have been broadcast, but to cite the broadcasting of the proceedings of the Sixth Latin - American Medical Congress some weeks ago, will serve as a good illustration. Special microphones and an amplifier were installed and each speech before the Congress was sent out over the air. The voice of the speaker was transmitted by underground cable to the transmitting station and the energy that entered the microphone was amplified over fifty-one billion times before going out through the ether.

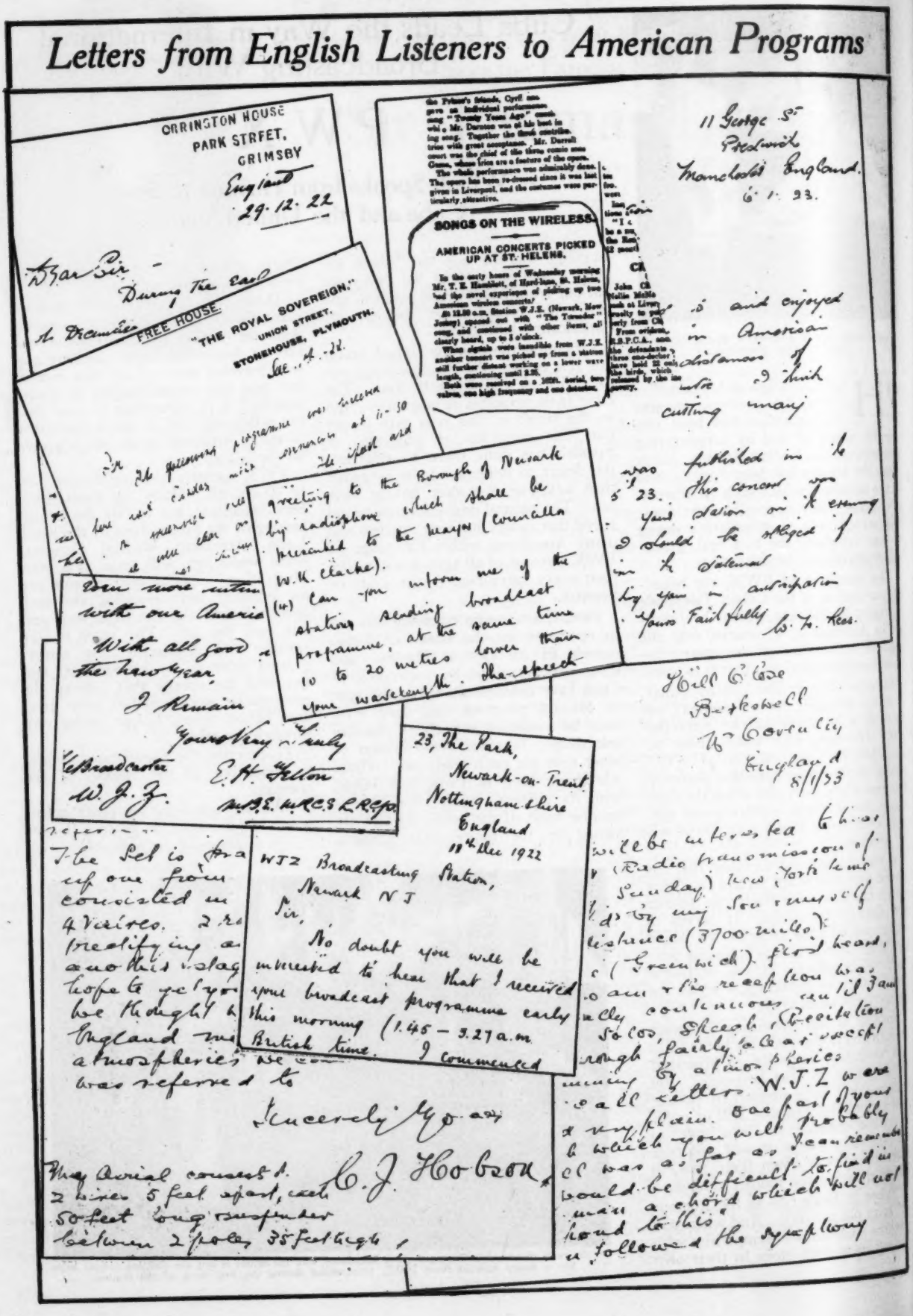
To describe the apparatus it is best to quote one of the officials of the company:

"We are operating on a 400-meter wave length using a perfect T-type

(*Continued on page* 44)

On the road to—no, it's Camaguey, not Mandalay, and the music is not the tinkling temple bells but a dance number from PWX, trantmitted during the first tests of the station

Letters from English Listeners to American Programs



"Listen, My Set, and You Shall Hear—"

Details of 48 English Receivers That Heard the United States—One Radio and One Audio Most Successful

REPORTS from the London Correspondent of THE WIRELESS AGE indicate that while the opening of broadcasting throughout England has transferred the great mass of popular attention from American broadcasting to that which is done locally, nevertheless the more skilled amateurs maintain eager ears cocked toward the stations whose calls begin with W and K. That in many cases they are entirely successful is an old story; but in England, and Ireland, too, when an amateur suddenly hears an American accent he calls in all his friends, including a newspaper reporter, or "pressman" as he is called, and also writes to the station he has heard. The result is much space in the newspapers, considerable local fame, and a steady flow into the bigger American stations of letters bearing English and Irish and Scottish postmarks. Some of this material is reproduced on another page; it will give an idea of the extent and scope of British reception of American broadcasters to say that WJZ alone could furnish enough letters and newspaper clippings of this sort to fill an entire issue of THE WIRELESS AGE.

It is interesting to note that some American radio enthusiasts have been receiving news of British reception of American programs both from these pages and from friends and newspapers abroad. One Newark man, for instance, keeps in touch with the old country through the Belfast "Weekly Telegraph." He had enjoyed the Christmas programs, and when his home paper, dated January 6th, arrived, he found in it an item that the same program had been heard and enjoyed in Belfast. Others who have friends or families in England likewise have heard from them by letters and newspaper clippings, some of them adding proudly, "We have our own broadcasting stations now, so we don't have to listen to America unless we want to."

It has been stated in these pages that the English were using receiving apparatus similar to that found in thousands of American homes. It is now possible to give an analysis of that apparatus, using for the purpose a table prepared by our London contemporary, "The Wireless World and Radio Re-

(*Continued on page* 44)

Reception of American Broadcasting Stations

Particulars are given below of the reception in England of certain of the American broadcasting stations. In addition to those below, many other reports have been received, though insufficient details have been supplied to conclude with certainty that the signals were of American origin.—*The Wireless World and Radio Review.*

Date	Name	Location	Apparatus: RF	Apparatus: Detector VT	Apparatus: Detector C	Apparatus: AF	Station Heard
Nov. 23							
24	C. M. Denny	Bebington, Ches.					
25	—Kelman	Guernsey, C. I.					WDY
26	R. J. H. D. Ridley of Burndept, Ltd.	Norwood, London	×	×	×		WJZ
26	E. H. Wilding	Wigan, Lancs.		×	×	×	WJD
Dec. 2	C. Keith Murray	Romsey, Hants.		×	×		?
2	W. R. Stainton	Leigh, Lancs.		×	×		WJZ
3	do.	do.		×	×		WJZ
3	F. W. Higgs	Bristol		×	×	×	WJZ
8	W. B. Parker	Monkseaton, Northumberland		×	×		WJZ
10	W. R. Stainton	Leigh, Lancs.		×	×		WJZ
10	A. L. Gay	Darlington, Durham.		×	×		WJZ
10	B. Gibson	Herne Bay		×	×		WJZ
10	R. W. Galpin	Herne Bay		×	×		WJZ
10	W. H. Webb	Manchester		×	×		WJZ
10	C. Shearston	Portsmouth	×	×	×		WJZ
10	A. H. Reade	Oxton, Birkenhead		×	×		WJZ
10	N. C. Hardman	Manchester		×	×	×	WJZ
10	J. W. Riddiough	Baildon, Yorks.		×	×		WME
10	Percy B. Todd	Lincoln		×	×		WJZ
11	D. A. Brown	Birmingham		×	×	×	WJZ
11	A. V. Chambers	Wimbledon, S. W.		×	×	×	WJZ
11	H. Aitken	Salford		×	×		WJZ
11	C. H. Nokes	Ripley, Surrey		×	×		WJZ
12	A. E. D. Kennard	Wangford, Suffolk		×			WJZ
14	A. S. Gosling	Nottingham		×			?
14	C. S. Bishopp	Cullompton, Devon		×			?
14	W. B. Parker	Monkseaton, Northumberland		×	×		?
18	F. Harper-Shore	Farnborough, Hants.			×		WJZ
18	W. R. Stainton	Leigh, Lancs.			×		WJZ
19	C. M. Denny	Bebington, Cheshire.			×		WJZ
19	J. H. Hill	Farnborough, Hants.			×		WJZ, WBY
20	O. F. Keurl	Bath			×		WEY
20	H. S. Woolley	Nottingham		×	×		WDY
20	Lott	Burnham-on-Sea					WJZ
20	J. W. Partington	Camborne, Cornwall.		×	×		WHI
20	Nesbit Burns	Somerset			×		WJZ
20	H. L. Bowen	Bath		×	×		?
23	T. B. Trott	Plymouth		×	×		WJZ
23	G. D. Adams	Pinner, Midx.	×	×	×		?
23	G. P. Kendall	Leeds					WJZ
24	A. Meredith	Shrewsbury			×		?
24	A. Krause	Sutton Coldfield			×		WJZ
24	R. C. Neale	Farnborough		×	×	×	WJZ
25	J. Ashworth	Bolton		×	×	×	WJZ
25	E. W. Null	Colchester					WDY
25	P. G. A. H. Voigt	London, S. E. 23	×	×	×		WJZ
25	J. W. Partington	Camborne, Cornwall.					WGY
25	F. Williams	Acton, W. 3		×			?
27	H. C. Gooding	Stowmarket		×	×		?
Jan. 2	H. R. Goodall	Southampton		×	×		?
7	A. F. Baldry	Wembley, Midx.		×	×		WJZ
8	W. R. Stainton	Leigh, Lancs.					WJY
8	W. R. N. Ward	Teddington, Midx.		×	×		WJZ
13	W. R. Stainton	Leigh, Lancs.					WGY
13	W. B. Parker	Monkseaton, Northumberland		×	×		WJZ, WDAC
14	A. E. Berlyn	Birmingham		×	×		WJZ, WZY, WDAF
16	V. M. Cartnell	Southport					WGY
17	F. D. B. Cobb	Margate		×	×		WJZ
17	W. D. Taylor	Sunderland			×		WJZ

"Hello, England"

Telephoning Across the Atlantic Causes a Sensation on Other Side—Still Far From Being a Daily Practicality—Future Is Promising

Hark! From the air an American voice—a six-foot square frame and a simple receiver sufficed to hear the trans-Atlantic voice tests

GREAT stir has been raised in England over the feat of "telephoning across the Atlantic." As was told in these pages last month, on January 14 the first official test was made between the Rocky Point, L. I., station of the Radio Corporation of America and the Marconi station near London. H. B. Thayer, president of the American Telephone & Telegraph Co., spoke into his office telephone in New York City, which was connected with the apparatus at Rocky Point. His voice thus hurled into space was heard in London, where a distinguished group of electricians, scientists and business men, including Senatore Marconi himself, listened in with ease. Details were given out to the British press, and a great commotion aroused.

Not nearly as much interest was evident in America, as it was realized on nearly every hand that it was nothing new that was being done. The voice was first transmitted from America to Europe during the war, on an experimental basis, and so far the work done has not raised the feat out of the experimental class.

Intensive studies of the various elements concerned in the new activity are being made by all concerned. It has been found that the reliability of communication by radio telephone across the Atlantic is much less than by telegraph. While the latter has its ups and downs, just as have the cables, it never disappears entirely, or gets beyond utilization by some of the means that are available on need. The radio telephone, however, goes so far down at times as to be practically out, as far as any understandable result is concerned.

In other words, trans-Atlantic telephony is still just about where telegraphy over the same space was only a few years ago. That it will be brought up to a parity with its elder brother goes without saying. Though some of the principles involved in radio telephony are different from those of telegraphy, in the main the two present similar aspects, and the fact that reliability has been brought to one is ample evidence that in time it will visit the other as well. Then it will be possible for a person almost anywhere in the United States to telephone, by land wires and radio transmitting and receiving apparatus, to a person almost anywhere in Europe.

Just how large such traffic will be cannot be predicted. At first sight it might seem that the rates probably will be such that the per word cost of a telephone conversation would be much greater than it is for telegraph messages. By telegraph, traffic flows both ways across the Atlantic at rates of 80 to 100 and even 120 words a minute; it is a rare orator who speaks at such speed, and over the telephone most of us talk much slower. However, the same argument was brought up when the trans-continental telephone was offered the public, and it has not been noticed that telegraph traffic across the United States has decreased, nor that the new facilities have been neglected; quite the contrary. The experience of public utilities, especially those dealing with communication, has been that the offer of new facilities seems to create new business.

Therefore it may be expected that inter-continental radio telephony will come in time to bear thousands of voices in both directions across the oceans.

The time is still distant, however. Probably it will come sooner than is expected; radio affairs have a way of bettering expectations.

Most of the development work is being done by American engineers, and late dispatches from England indicate that there has been much criticism of the British officials for lagging behind. "How is it that America has these powerful transmitters that hurl the voice over 3,000 miles to London, and we do not have them and so cannot reply to our energetic American cousins?" is the query that is being asked by the Britons. It is rather a natural question, yet betrays rather general ignorance of the elaborate interlinking that characterizes the radio world. By reason of the controlling position of patents covering methods and apparatus used for commercial radio apparatus, and agreements relating to cross-licensing and exchange of information among the various radio

(*Continued on page* 44)

Electrical experts in London hear the voice from America. Senatore Marconi may be seen in the right center, and the other guests are prominent English radio and telephone engineers

How Radio May Help the Theater

Roi Cooper Megrue, Successful Playwright, Says It Will First Hurt, Then Aid the Stage

By Geo. W. Gether

This beautiful salon shows no sign of a radio set, yet one is there, speaking continually to Roi Cooper Megrue and his mother through an attachment on the phonograph

"THEY say that radio hasn't hurt the newspapers," said Roi Cooper Megrue, "but anyone can see that it beats them in some ways. It beats the theater in some ways too, and I think it is going to hurt it. Not here in the big city where there is always a multitude of visitors who insist on going—so that they can boast back home of the 'outrageous' prices they had to pay—but in the rest of the country, where the road companies go. It's so much easier and cheaper to sit at home and be entertained by radio, and I should think people would rather do it, and get good stuff, than pay real money to hear third-rate road companies. What it will do, eventually, may be to bring better plays to the smaller towns. It may cut down the output of poor ones, and give a better chance to the good ones, and so in the end it ought to be beneficial. No one hopes so more than I do. No, I haven't a single play on the stage now, but I'm working on one.

"Isn't radio spooky? Just think, to sit here and turn a knob and hear someone speaking or singing or giving an opera or a play or what not, out in Newark, or Chicago, or St. Louis, or Atlanta."

So perhaps New Yorkers and visitors to the Great White Way may some time soon see a new mystery play with radio as the source of thrills. Roi Cooper Megrue gets quite excited about broadcasting, and as he is a playwright, a very successful one too, it would be strange if he didn't put his new experience into a theatrical production. We intended to spend half an hour with him one night recently, but it turned out to be two hours instead, and WJZ was just clearing its throat preparatory to signing off as Mr. Megrue said "It *is* spooky, isn't it?" for the third time, walking with us to the door.

During the entire visit he and his Westinghouse RC receiver had been talking quite steadily. "I keep it going all the time, as long as there is anything to listen to," he explained. "I miss it if it is quiet. Some time ago the house electrician connected up a battery charger for me, and because he didn't know anything about it he reversed it somehow and blew out all three bulbs. That was on a holiday, one of the week-end ones, and I couldn't get new bulbs, so for two days we couldn't hear a sound. It was like a tomb in here—not that I'm a dead one," he added quickly. "You can't hear a bit of noise from Broadway, do you notice? Radio brings the world in, and the best part of it, too, with all the stuff you don't want kept out. Though I must say that personally I'd be better pleased if they didn't put on so many coloratura sopranos. Mr. White's descriptions of boxing matches are great. You can hear him get excited. He gets his own thrill over to the audience. Even my mother sat on the edge of her chair during that Britton-Walker scrap."

They say that playwrights portray best the characters they love most. Mr. Megrue has been very successful in writing the dialogue for the dainty, aristocratic, lovable old ladies that appear in some of his plays, and now we know why, for we have met his mother.

"Oh, I think prize fighting must be brutal and just too awful, and I wouldn't think of ever going to a fight, but I could hardly wait to hear if Britton was going to stand it until the last round," said Mrs. Megrue from the divan whose deep comfort she had sought after hospitably welcoming us.

"Some people who come here complain about the radio," she continued, "and say, 'it makes me nervous, do turn it off,' but it makes us nervous not to hear it." And certainly the two, mother and son, were happy and contented as they sat there. We couldn't for the life of us tell which was prouder of the other, nor which enjoyed broadcasting most.

Mr. Megrue doesn't look like a playwright. No flowing hair, no temperamental expression. A business man, perhaps one would say on regarding him, an artist on visiting his magnificent apartment, and a genius on seeing his plays. We have a feeling that his plays express him best, and that the apartment, remarkable as it is, is more a tribute to his mother than a reflection of himself. The room in which he works is his, surely, with its antique desk, its books, and the hundreds of photographs of actors and actresses framed upon the walls, all autographed and many bearing famous names.

It is the rest of the apartment that we think he has arranged as a tribute to his mother. Rare Oriental rugs, carved walnut furniture, interesting works of art, all form an *intérieur* that Mrs. Megrue graces admirably. Even the radio set is in keeping, for the receiver is on a table in a little alcove where it is inconspicuous, and it speaks by means of a Vocarola attachment on the period model Columbia graphophone, which is the only evident source of the radio programs.

What Radio Means to Me

By F. Howard

WE hear so much about radio from a commercial point of view. But did it ever strike you that it is just as great a boon to the hospital patient? I am in a position to speak with some degree of authority on this subject, being a victim of tuberculosis which was contracted in the World War, besides being a bed patient for close upon two years.

The first year and a half, I did not know what to do. First I tried reading, then bead work and reed work, only to discard them as my strength failed and my interest palled.

It was then that I felt the need of something instructive and interesting, something that would require the least amount of energy. So I started looking around for new worlds to conquer and hit upon radio.

I shall not go into details about how it was installed, except to say that it was constructed entirely by myself whilst in bed, with the assistance of a fellow patient, an old Marconi wireless operator, to whom I am greatly indebted, and since it has been installed, my general condition and also my mental condition has greatly improved, which plays an important part in the treatment of tuberculosis.

F. Howard in his Canadian hospital with the aid of radio endeavored to recover from his war-time disabilities

Few doctors pay much attention to that side of the question when dealing with bodily sickness, while they will admit the importance of it. And I am very sorry to say that I have not received a great deal of encouragement from the doctors here. They all, with only one exception, regard my efforts to entertain myself and others with wireless, as some crazy new-fangled stunt, and look upon radio as a fad. But the day is not far distant when radio receiving sets will also be included in all standard equipped hospitals, sanatoriums and asylums.

Perhaps you will remember some time when you were an invalid either through sickness or accident, or some of your loved ones were, or are, in the same plight. Remember then the great need when the call is made, as it will be, for radio is in the sick room and is in to stay. Few will scoff at the idea, but rather will bless radio for what it is doing for the sick.

Work and Play by Radio

Californian in Wheel Chair Listens to Broadcasting While He Does Dental Laboratory Tasks

DESPITE Native Son assertions that California is but one step removed from Paradise, it appears that it is one with the rest of the world, in holding its quota of aches and pains, mental and physical anguish. There sickness sometimes rules a human life imperiously, as it does elsewhere. There also live those who are shut within walls. And there also radio is doing its marvelous service of relief to the minds of those who thought themselves forever walled off from the active world.

Let us take Dr. D. I. Wadsworth as an example. Dr. Wadsworth lives in Pasadena. He has been sitting in a specially designed chair for six years. The chair is as comfortable as it is possible to make it, but it has wheels. It is the chair that has to move, because the doctor's legs can't.

Dr. Wadsworth has a little workshop in which he spends most of his time. There he does dental laboratory work. The Pasadena dentists know him well as an expert and careful craftsman, and they get him to do such work as making plates and bridges, in fact all the varied laboratory work that a busy dentist cannot do himself.

While he works at his bench with his crucibles and moulds, his gold and rubber and enamel, he listens to broadcast concerts, news, lectures, all the programs of which the California air is so full. He used to be active, in touch with the many activities of his city and state. For six years his activity had to be confined to his home and shop, to which come the newspapers, his friends and associates, and now radio broadcasting.

Dr. Wadsworth, Pasadena, Cal. sits in his wheel chair listening to radio concerts

It was radio that brought the world back to him as no other thing had done. "I chafed at restraint," said the doctor, "though I can't say too much for my friends, and for the newspapers and magazines, still they are not like seeing and hearing for myself as I used to do. Radio is like all the world brought to visit me.

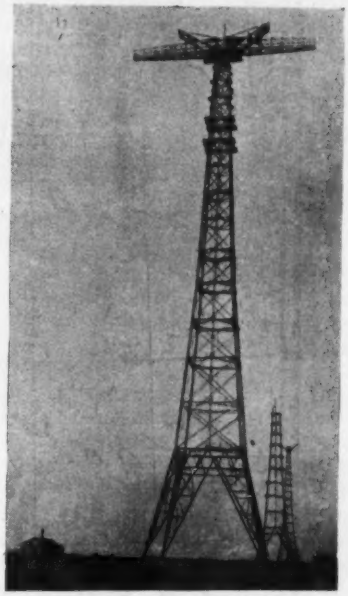
"I know every operator's voice at every local station. Music, especially phonograph music, evidently is hard to get into the air, but my loud speaker gives it to me just as clear as a bell. In regards to KHJ, I want to tell you that in my opinion it is the best of them all, perfect modulation and audibility. Uncle John is some announcer, and I would rather hear him than listen to the best piano that was ever made. Yes, sir, radio pours the whole city, all the Coast right into this workshop as I do my work. Why, I'm more entertained and better informed than I was six years ago when I could walk around with the rest of you."

Poland Becomes a Neighbor to the World

New Trans-Atlantic Station Near Warsaw Will Begin Operation in Near Future—Has Been Building Two Years—Power Plant Contains Unique Features

BY next summer Poland will be in direct communication with the United States by radio. Then it will be no longer necessary for messages to go by telegraph to other countries for transmission by cable or radio. Poland's new radio station will complete her liberation from bondage to other countries, and will make her an independent member of the family of nations, no longer dependent on the facilities and good will of her neighbors for communication with the rest of the world.

Not only will the new radio station give Poland direct exchange of radio traffic with the United States, but it will also provide immediate touch with all European radio stations. In fact, since the installation now nearing completion is in the main a duplicate of the Radio Central plant of the Radio Corporation of America, at Rocky Point, L. I., communication with nearly the entire world is expected to be placed in Poland's grasp when her station is put in operation.



From the antenna swung from these giant towers in Poland messages soon will zip across the Atlantic

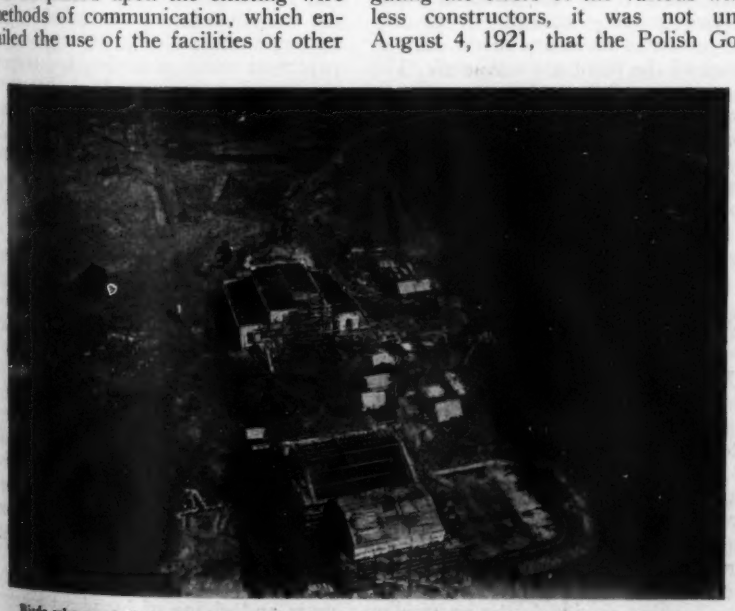
It was early in 1919 that the then newly-constituted Polish government realized that direct communication with the world, and especially with the United States, was an essential. Surrounded as she was by nations whose hostility was either open or hardly concealed, she knew that reliance could not be placed upon the existing wire methods of communication, which entailed the use of the facilities of other nations. Wireless was the one most flexible, efficient and certain solution, and the determination to erect a radio station of high power was taken early in the history of the new nation. However, due to the necessity for placing finances in order and investigating the offers of the various wireless constructors, it was not until August 4, 1921, that the Polish Government signed the contract for the station it so eagerly desired. By this contract the Radio Corporation of America agreed with Poland to construct for it an international high-power radio station of the most modern type, at an approximate cost of $2,000,000, and to have it working in 1923. The promise is being kept, and actual operation of the new plant will commence in a few months.

In fact, already messages are being exchanged by radio between the engineers in Poland and those in New York City. The force in Poland is equipped with a broadcast receiver that has been fitted with loading coils so that it is capable of tuning to the long wave lengths of the Radio Central transmitter, and messages for Poland are sent direct on a regular schedule. Replies are sent through the German station at Nauen.

The new station is interesting in a number of ways, besides its general resemblance to the famous Radio Central plant. Probably the most striking feature of the installation is the power plant, in which some unusually difficult engineering problems had to be solved. There being no available source of suitable electrical energy, a separate electrical generator plant had to be provided. This contains two engines, one a Diesel, and the other a steam turbine, each of 750 horsepower, and each coupled to electrical generators.

By means of suitable switching arrangements these two power plants, or "prime movers," as the engineers call them, may be coupled in several different ways. The electrical energy they produce is consumed by two Alexanderson alternators of 200 kw. each, and by the necessary auxiliaries. Means have been provided whereby either of the prime movers may operate either alternator and either set of auxiliaries, or both power plants may be focused on a single one if conditions necessitate it.

At first glance it might seem that this would be a mere matter of throwing a few switches, but as a matter of fact, much more than that is involved, due to the fundamental difference between the power delivered by the Diesel engine and the turbine. The Diesel is an internal combustion engine, operating on much the same principle of the automobile engine, but with certain important modifications that render it suitable for delivering



Birds who perched on one of the Polish towers last September, when this picture was taken, saw the power house and alternator house approaching completion. The moats of the ancient fort may be dimly seen at the right

high power under steady load, and operating on low grade fuel oil. The power delivered by a Diesel engine is not constant and steady, as is that of the steam turbine, but is generated in impulses corresponding to the explosions within the cylinders. There is a decided tendency, therefore, for the current produced by an electric generator driven by a Diesel to vary considerably in voltage.

The engine in the Polish station has five cylinders and operates at 167 revolutions per minute, so that there are only 400 explosions a minute, or 400 power impulses. In normal service the resultant irregularity in generated current would not be sufficient to cause concern, but it is vital that the current supply to the Alexanderson alternator be constant within exceedingly narrow limits. That was the problem involved in the Polish power plant, and it has been solved, which is a great tribute to American engineering genius.

In fact, nearly all the equipment of the station is of American design and construction, the Diesel being the only important unit that was not produced in America. The General Electric Co. made the steam turbines, the electrical generators, and of course the Alexanderson alternators. The Diesel engine was made by a Belgian firm, the Société à l'Électricité et de Méchanique, of Ghent. The steel towers are of Polish manufacture.

Two main buildings house this equipment, the alternators being given a structure to themselves, separate from the power house. They are located just west of the city of Warsaw, on a level plain, near an old fort known as Fort 11-A, some of the concrete of which was broken up for use in some of the foundations of the radio station. The two antenna wings are approaching completion. Each consists of five towers, 400 feet high, with bridge cross arms at their tops, 150 feet long. Twelve wires are suspended from these towers, forming the antenna.

The transmitting station is between the two arms, which are directed toward the United States. Each wing of the antenna may be used separately for simultaneous transmission to two different points, or they may be connected together for maximum power and range. Weather conditions are severe at Warsaw, and provision is made for sending heavy currents through each wire of the antenna, to clear it of sleet and snow. The wires are two miles long. A network of buried wires forms the ground system.

Receiving will be carried out at Grodzisko, a small town about twenty miles south of Warsaw, where several old buildings are being remodeled.

Poland not only has a corridor to the sea, gained in war, but is building near Warsaw, the capital, a radio station that will give her access to the ears of the world by wireless

In accordance with modern practice, both the transmitting and receiving stations will be operated from a central office, in Warsaw. The necessary land wire telephone and telegraph circuits connect the central bureau with its two outlying stations, where only the personnel necessary to the maintenance of the plant are stationed. The apparatus used in the Warsaw office is similar to that in the Broad Street office of the Radio Corporation of America, New York City, including automatic transmitting and receiving machines. Operation at high speed is to be a daily occurrence, a speed of 80 words per minute being guaranteed.

Joint Chicago and New York Meetings Broadcast

WHAT is understood to be the first linking of radio broadcasting with the Western Electric public address system took place on February 15, when the address system itself also was given its first demonstration of two-way operation. The occasion was the mid-winter convention of the American Institute of Electrical Engineers, meeting in New York City. The evening session in the auditorium of the Engineering Building was conducted with the aid of the system, as was also a simultaneous meeting in Chicago, with a telephone wire connection between linking the projectors in each city.

Every word spoken in either hall was heard perfectly in the other, and the two audiences participated in presenting and discussing two engineering papers as easily as if they had been in the same room instead of 900 miles apart. In New York City station WEAF broadcast the proceedings by radio, just as they were heard by the meeting in that city.

Boy Scouts Celebrate

BECAUSE the Boy Scouts are great users of radio receiving and transmitting sets, celebration of the fourteenth anniversary of the organization was done in part on the air. On February 12 broadcasting stations in all parts of the country transmitted the address of Dr. George J. Fisher, Deputy Chief Executive of the Boy Scouts of America, pointing out the achievements of the membership in heroism, social service and service to the nation, not forgetting the many instances in which social service took the form of presentation of r dio receiving equipment and giving of broadcast concerts to those in need of radio's benefits.

Finding the Way in Cloudland

By Capt. Robert Scofield Wood,
D.F.C., M.C., C. de G., R.A.F.

SINCE the Chinese mariners, centuries before the Christian era, used the lode-stone for purposes of navigation there has been no fundamental change in the theory or practice of this science. Of the many improvements, changes and adaptations which have marked the evolution of the magnetic compass down through the ages there has come to its aid no one thing quite so important or revolutionizing as radio.

It is an all-embracing step from the days of the slow-moving north-seeking natural magnet suspended before the wheel in a Chinese junk to the radio compass of today installed in the fuselage of a giant aeroplane, for within this span lies the history of civilization. Radio has in no way displaced the magnetic compass or lessened its value, but quite to the contrary, has made it inestimably more valuable. It has made aerial navigation possible and safe under conditions hitherto considered unsurmountable.

Aerial navigation up to the present time has been a more or less inseparable combination of pilotage and navigation. This, because aviators under ordinary conditions use the compass for directional purposes only in a general sort of way and depend largely upon natural landmarks by which to check their position. This is only a natural procedure, with the earth lying as an open book in all its intense fascination practically at one's feet, and in a reduced size by reason of the craft's altitude.

Take as example a flight from New York to Albany. While the course would be a straight line between these two cities, no aviator would for a moment think of endeavoring to steer by keeping his eyes glued to a compass in the cockpit. Landmarks such as the historic Hudson with its innumerable distinctive turns and twists are everywhere, to keep him going straight with the least amount of physical and mental strain. Time and position are checked by various cities, towns, woods, lakes and bends in the river as they are passed. This indifferent process, one per cent. navigation and ninety-nine per cent. pilotage, is followed unless bad weather, accompanied by poor visibility, fog, rain storms, snow, hail and terrifically high wind, low clouds and the bugaboo of aviators, "ground mists," are encountered. Under such conditions a strict observance would be paid to the otherwise neglected compass and position would be checked at every available opportunity, whenever a rift in the clouds or mist presented a fleeting view of the earth below. It is under such adverse conditions that pilots get lost or meet with disaster in coming down through the low clouds to get a peek at the ground in order to locate their exact position.

Even night flyers, the most intrepid airmen, to whom flying is almost second nature, depend upon prominent landmarks to assist them in reaching their destinations. Strange as it may seem, roads, rivers, lakes, forests and cities are distinctly visible on all but four nights of every month. This is, of course, barring stormy sessions. During these four nights there is no reflected or refracted light in the heavens and consequently all natural landmarks are indistinguishable, even the ever-present horizon seems to fade out, leaving the world in what the poets are pleased to call Stygian darkness. The night flier, who by virtue of his experience has acquired the knack of turning to immediate use everything that presents itself to help him in his perilous work, wages an eternal battle with the unfriendly darkness. It is during the four nights of extreme darkness each month that most of the aerial after-dusk tragedies occur. It is to aid the aerial navigator in meeting and successfully coping with these conditions that the radio compass finds one of its most useful adaptations.

For trans-Atlantic flights or trips across great uncharted areas such as the Sahara Desert or the primeval jungles of Africa, whether by day or night, the need for pure unabridged navigation can easily be seen. Because of the great speed at which aeroplanes travel the errors of the magnetic compass are magnified greatly, and serious deviations from the desired course sometimes result. It has been said, and quite properly, too, that there is no margin for a mistake of any description in aeronautics. Hence radio in its absolute accuracy has filled this need, and, assisting the compass, makes a combination indispensable to the safety of all aircraft.

There are on record only four cases where aviators have relied upon marine navigation alone in over-sea flights. These are the historic flights of Major Reed, A.F.C., U. S. marine flier, and his squadron of N.C. planes. Captain Jack Alcock, K.C., D.S.C., R.A.F., both of heavier-than-air trans-Atlantic fame, and Major "Get There Scott," D.S.O., who made the round trip from England to America in the R34, sister ship to the ill-fated R4. Navigation common to that used on ocean liners was resorted to in these four trans-Atlantic trips.

Wireless navigation then was in its infancy, so far as aircraft was concerned, and, not being understood, was consequently unfavorably looked upon by flyers.

Considering this, it would be hardly fair to expect any of the men who made these historic "jumps," bridging the old and new worlds, to trust themselves to an uncertain quantity, for it must be borne in mind that up to the

time of these flights there were only three aeroplanes equipped with radio navigating instruments. Two of these were Handley-Pages of the two-engine type, one belonging to the famous 96 Squadron of the Independent Air Force, the other assigned to No. 2 School of Aerial Navigation and Bomb Dropping at Andover, on Saulsbury Plains. The third set was installed by the writer in a super-Handley-Page in anticipation of testing radio's practicability in what was to have been the first attempt to cross the Atlantc ocean by air in the early part of 1919. Two planes were to have started on that trip, one under the command of Major Darley, D.S.C., D.F.C., R.A.F., Commander of 166 Squadron, and the other, under command of the writer, was to have been navigated by wireless.

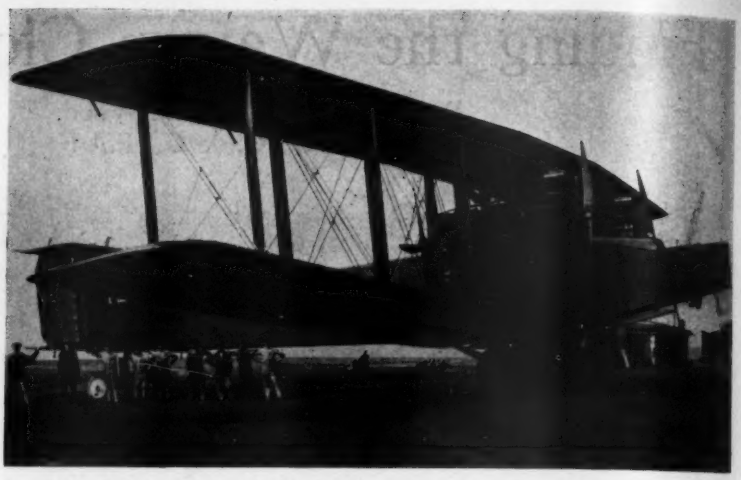
After equipping and testing the apparatus for nearly four months, during which time radio navigation tests under the severest flight conditions were made all over continental Europe, we returned to our base in Norfolk, England, having proved to ourselves the worth and reliability of the aero radio compass.

The Air Ministry during our absence had either suffered a change of heart, desire or administration and after many conferences called the trip off, much to our disappointment.

When the official "wash out" came we lost all interest in the work that had consumed our every thought and movement for months and the wireless instruments were removed from the machine and the last seen of them was as a jumbled heap lying inconspicuously in a damp army storeroom where in all probability they still are. So you can see that nothing was really accomplished then, officially, with aerial wireless navigation.

Three years have elapsed and wireless, or radio as it is now called, is being applied very successfully to everything now, including aerial navigation.

The method of determining the position of an aeroplane today, while identically the same from the standpoint of theory, as it was when the electromagnetic waves were first applied to aerial navigation, has reversed the location of the actual instruments and placed the burden of the calculations in the hands of three widely separated wireless stations on shore, which function as one Radio Beacon Unit. This, as you can readily realize, is of great advantage to the navigating pilot. It minimizes, in the first place, the possibility of an error, relieves an already overtaxed navigator of a vast amount of tedious detail, and last, but not least, saves minutes



A veritable Goliath of the air is this Handley-Page machine, flown by Capt. Wood for the Royal Air Force. Its tremendous size can be judged by the aviators and mechanics, standing proudly, as well they might, beside the craft

in situations where the margin of safety is measured in fractions of a second.

In the early days of radio navigation all calculations were made in the aeroplane by using the same type of apparatus as is used in the radio beacons on land today. This consists of a loop aerial and a receiver composed of four steps of radio frequency, a detector and one step of audio amplification. Working in conjunction with this apparatus were the usual compasses, charts, course and drift indicators, sextants and chronometers, all assembled within the confines of the fuselage. In addition to these numerous instruments, an oxygen generator and a large map board were squeezed into the already overcrowded space, to say nothing of a set of graphed mirrors so arranged as to reflect the image of a dummy compass card fixed beneath the loop aerial. The movable dummy compass card could be swung through a complete arc until its reflection in the mirror indicated that it was pointing in the same direction as the needle of the magnetic compass—north. This enabled accurate compass readings to be made from the position indicated by the loop aerial when the signals were being heard at their maximum intensity. Silent readings were also made as a check. This seemingly complicated arrangement of aerial and compass was necessitated by the lack of space, which would not permit the mounting of the loop above the large compass as is common in marine installations.

The early experiments which were conducted during the winter of 1918 and 1919, just after the armistice was signed, were more than gratifying in their results. By special arrangement with the Air Ministry, Europe's three most powerful stations, Poldu, at Cardiff, Wales, the Eiffel Tower at Paris, and the American station at Bologne, on the north coast of Normandy, transmitted an identifying signal for ten minutes every hour beginning at five minutes to the hour. Each station for the special purpose of these tests transmitted on a widely different wave length, thus affording the aerial navigator ample time in which to make three or four complete and separate "fixes" for triangulation.

The results of these tests were the subject of much discussion in navigating circles. Time and again representatives of the Royal Navy who might charitably be called "Doubting Thomases" went on flights to show how much better and more nearly correct a position could be fixed using the marine instruments. Their efforts in this direction were rather futile, for not once in some twenty comparative tests did the Navy navigators come within miles of the exact position, while the radio calculations proved infallible.

With the radio apparatus installed in a super-Handley-Page bombing plane, tests were carried out all over Europe under the most adverse flying conditions and not once in two hundred and twelve hours of flying, most of which was done at night in the fogs that cover all of Western Europe in the fall and winter, was the aviator unaware of his exact position.

To-day things are much more conveniently arranged and no longer does the aerial navigator try, with fingers numbed with the cold, to pick up elusive pieces of string and stretch them across a chart or map in order to get his craft's location. With the radio system now in operation under the supervision of the United States Navy, all that is necessary for a pilot

to do, to obtain his exact location, is to signal Uncle Sam's radio beacon service, which functions twenty-four hours a day. In this service, which has been established for the sole purpose of giving ships and aeroplanes their exact locations, there are forty-two separate stations which operate in fourteen sections, three to each section, guarding the coast from Maine to Florida.

The pilot only has to call the radio beacon service on the designated wave length of 900 meters and transmit the registered call letters of the aeroplane for a period of three minutes. The exact location is flashed back to the inquiring pilot within two minutes. During the three minutes of transmission three widely separated stations have heard the signals, made the necessary calculations and transmitted their findings to the central station of the group, where the bearings are plotted and the lines projected on the chart or map, the machine's location ascertained, and the information transmitted to the waiting pilot.

The radio beacon service makes an average of thirty "fixes" a day for aeroplanes requiring their exact locations. This has been going on for the past six months and not once during this time has an erroneous location been transmitted.

Aero-radio equipment to-day consists of a small compact fifty-watt transmitting set and a receiver using one step of radio frequency, a detector and the usual two steps of audio amplification.

So important has radio become to successful aerial navigation that no machine is considered to be properly equipped unless it has the necessary apparatus aboard to make use of the radio beacon service.

Not only is radio indispensable from the standpoint of successful navigation, but also to the general safety of the passengers and the craft as well. With the proper equipment the plane is never out of touch with land and can be notified of any and all changes in weather conditions and in event of a storm the pilot is immediately notified of its strength and direction, together wth its location and how it may be avoided. This is very important and useful information in the hands of a pilot and goes a long way in making commercial aviation infinitely more practical.

In England, where aeronautics is on a paying commercial basis, radio is playing a bigger and more important and indispensable part every day.

Every pilot in the commercial service between England and the Continent is required to report his position every fifteen minutes to the Central Aero Control Office, so that the progress and position of every machine in flight can be followed. This is a radio development which the most imaginative mind of a decade ago could not have conceived.

New KDKA Record

KDKA, the famous pioneer broadcasting station in Pittsburgh, Pa., recently learned that it set a new distance record, having been heard on a ship at sea 5,000 miles distant. While the reception was on Oct. 5 last, the report of it only reached the station recently, from E. G. Osterhoudt, wireless operator of the S. S. *J. A. Moffett*. He wrote that his log showed that at 9.30 p. m., local time, October 5, while the ship was off the Peruvian coast, 3,453 miles south of San Pedro, he heard KDKA playing "Stumbling." The position given is 5,000 miles, air line, from Pittsburgh, and the fact that Osterhoudt really heard the station has been confirmed by reference to the KDKA program for the date.

"We Heard You Calling Us"

IT'S a mighty rash thing to promise things to the radio audience—there are so many people listening. Mayor Rolph, of San Francisco, now knows this, and it has cost him something over $3,000 to find it out. When he dedicated a new broadcasting station at the Golden Gate he said: "I want to find how far my voice is carrying, how big my audience is. Send me telegrams and send them collect. Come on, everybody." And everybody did. The flood commenced at midnight, poured forth from every state in the union, from Honolulu and from a ship in the Pacific. Every wire was marked "collect," and the mayor says he didn't realize that he was broadcasting his salary as well as his voice when he asked for telegrams.

1/11/23 SAN ANTONIO EVENING NEWS

Amateurs Who Disregard Laws of Radio and Stations Organizing Clubs Declared to Be Nuisance

CHARACTERIZING the organization of "clubs" by radio broadcasting stations as an abuse of the privileges granted under a Government license for broadcasting, Ellis Chaney, vice president of the Southern Equipment Company, operators of radiophone station WOAI, Sunday night appealed to radio fans to discourage such practices.

The amateur telegrapher "worker" who is unwilling to co-operate, interferes with the rightful pleasures of thousands, disregards laws regulating wave lengths, and constantly interferes with radio concerts, is a nuisance in radio, Mr. Chaney said. The address delivered by Mr. Chaney and broadcast by WOAI Sunday evening, follows:

"Every owner of a receiving set which has a range of 300 miles and over is entirely familiar with the recent idea of some broadcasting stations organizing so-called clubs. It has been suggested to us by some that WOAI should fall in line and organise a club—one gentleman going so far, in an effort to co-operate with us, as to outline briefly by letter the character of matter to be broadcast. He also suggests a name for the proposed club and if we were going to undertake the club idea, we would be very much interested to consider the plan and we want to thank this gentleman, whose name is unknown to us, for his interest shown and compliment him on the original and amusing article which he submits as a proposed opening or introductory announcement.

"In our opinion, the novelty quickly wears off and listeners in become tired and weary, and, in fact, provoked with the reading of names and addresses of those who have written a station in application for membership in a club, or, for that matter, regarding having heard their broadcasting.

"We think stations such as KSD of the St. Louis Post Dispatch are apt to retain the best will of radio receiving set owners simply because they maintain their dignity by not broadcasting anything except of general interest, such as high-class music, current news items, market reports and weather forecasts, without sidelights, and we are always pleased when we are able to tune in on such a station and we admire and compliment them for dignity and respect for those people who have radio sets in their homes.

"It has been and will be our purpose to maintain WOAI as a dignified station which people will always be glad to listen to.

"We believe it is an abuse of the privileges granted under a Government license to perpetrate various nuisances on the radio public in the form of ridiculous attempts at wit and humor, which is nothing more or less than plain shoddy advertising, which we hope will soon be more closely supervised by the United States Department of Commerce officials.

"We greatly appreciate receiving communications from listeners-in who have heard our programs and we invariably and immediately pass all complimentary letters on to the artists who perform for you over WOAI and it pleases these artists just as applause would from an audience in a hall or theater. We not only do this, but a great many of such letters and cards are printed by the Evening News and Express, which, in a general way, acknowledges receipt to the sender, but we also acknowledge every letter and card we receive by mail, sending our appreciation and our broadcast schedule. We have received many thousands of cards and letters from all over the continent and have them filed by States or countries and we are very proud of them and want more and will appreciate, in the future, as in the past, the thoughtfulness which prompts anyone to write, but we believe you also appreciate the fact we should not spoil many people's entertainment by reading each card, in spite of the fact you might be interested to hear your name sent through the air.

"Next to almost incessant interference of the amateur telegraph 'worker' —frequently entirely unwilling to co-operate and regardless of the laws regulating his license, if he has one, respecting the wave length he may use and that he should always remember it is unsportsmanlike to unnecessarily interfere with rightful pleasure of thousands—the biggest detriment to and nuisance in radio is the broadcast station which is constantly indulging in 'horse play' of the nature just mentioned. If we were goig nto pray together we would request you to join us in a prayer that a remedy for both of these impositions is shortly found."

Radio Program by First

PWX

(*Continued from page* 33)

three-wire antenna, 110 feet long, supported by steel towers 90 feet above the roof of the building, the latter being 80 feet high, making a total of 170 feet. The lead-in is 170 feet long. We are not using a counterpoise system.

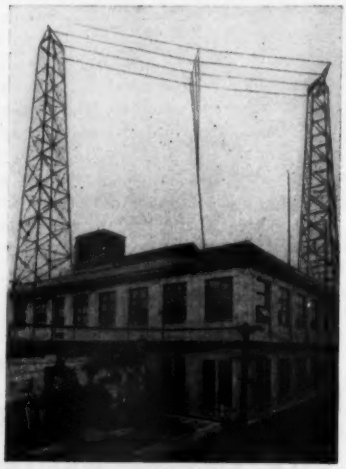
"The apparatus consists of a Western Electric transmitter, designed to deliver 500 watts of radio frequency power to the antenna system, using two 250-watt modulator tubes and two 250-watt oscillator tubes, employing the Heising system for modulating. The speech amplifier amplifies sufficiently to modulate the radio frequency. In the studio we are using a special high quality microphone.

"We have had great success, and have received notices from all parts of the States, and from Toronto, Canada. I also believe that this is the first Latin-American broadcasting station to announce in both English and Spanish.

"I really do not believe the Cuban public will take to radio quite as fast as they have in the States. You will realize the climate will account for this to a great extent, keeping people out of doors, and there is not the perpetual broadcasting that is done in the States."

During the time when the Cubans were attempting to float a loan in the United States, the station was used liberally by the government to explain the need for the money, and the public sentiment thus created had a far-reaching effect in making the effort a success.

There is no question but that through PWX Cuba has strengthened the bonds of friendship between itself



and the United States, and as the service of PWX expands, as they undoubtedly will, these ties will become even more durable than ever.

Cuba does not seem so far away, now that we can hear her voice every night.

English Receivers

(*Continued from page* 35)

view." This table, which is printed herewith, lists 48 cases of reception of American broadcasting, giving the outlines of the apparatus used.

It will be found that the combination of one radio frequency amplifier, detector, and one step of audio frequency is the most frequent, occurring 17 times in the table. Second place, and a poor second, goes to a simple one step of audio frequency, 8 times. Third place, one radio and two audio, is close behind with 7 instances. And fourth, also close, is the surprising detector only, in 6 cases. Use of the detector alone is, of course, the most popular American practice, and one and two steps of audio frequency next. Those who experiment with radio frequency usually start with one step. Only one unusual arrangement is to be found in the entire list—the use of two steps of radio frequency and then a crystal detector.

This table, while highly interesting, and significant of the great interest in the subject in England, should not be taken too seriously as to its indication of the best type of apparatus. The apparent great success of the one radio and one audio frequency arrangement does not necessarily mean that this is by far the best. It may be that that is the hook-up that is at the present most popular in the British Isles, and the total of 17, while large in proportion to 48, may be small in relation to the total number of such sets. Again, the use of two steps of radio and one of audio, extremely popular in this country, is reported only twice in the table; some Americans, enthusiastic over the performance of such sets here, may jump to the conclusion that there are only two such receivers in England!

It is instructive to study the list of call letters, some of which are most obviously wrong. WDY, for instance, is named several times, though that station was closed down months ago. "WJD" is, of course, merely WJZ misunderstood. The English pronounce the letter Z as "Zed," instead of the American "Zee," and the Englishman unfamiliar with this difference in alphabet, naturally would be confused.

Another call that has been giving the English listeners difficulties is WGY. In fact, American fans have often been puzzled by one of the announcers' slurring of the G. To an American the location "at Schenectady, New York," usually means the end of the mystery about the call letters, but not to an Englishman, and so we have WGY in the table appearing as WDY, WHI, WBY, WEY and WZY.

SETS ACROSS THE SEA

Detector only	6
1 step audio frequency	8
2 steps audio frequency	3
3 steps audio frequency	1
1 step radio frequency	1
1 step radio and 1 audio	17
1 step radio and 2 audio	7
1 step radio and 3 audio	1
2 steps radio and crystal	1
2 steps radio and 1 audio	2
3 steps radio	1
	48

"Hello, England!"

(*Continued from page* 36)

companies of different nationalities, work done by one eventually becomes available for all.

For all to undertake the same development activities would mean a useless duplication of effort, and the work naturally gravitates to the country most fitted to perform it. In the case of the radio telephone, America contains the world's foremost experts in all phases of radio telephony, and it is entirely fitting that they should be the ones who are developing its newest expansion into a medium that will conquer the seas as radio telegraphy has.

This is not to say that the English engineers are not expert in the subject, or have not been working upon it. The success of their broadcasting efforts from the start testifies to this, and in the present trans-Atlantic experiments they are playing a daily rôle, even if it is a listening rather than a speaking part. American engineers have been assisting them in this, in order to gain practical experience in reception of voice transmission on the longer wave lengths—1,800 meters was the length used in the first test—so that on their return to this country they will have the basis for operation when England begins to talk back to America and it becomes necessary on this side not only to send by voice, but receive.

The present status of trans-Atlantic telephony therefore may be considered as that of a great cooperative experiment, in which the laboratories are the best radio plants of America and England, and the experimenters the foremost experts of both countries. That it will become a commercial practicability in time is certain, but at present it is entirely experimental.

Recording Our Broadcasts in England

Unprecedented Feat of Permanently Recording Speech and Music From America Successfully Accomplished — American Broadcasts Heard for Eighteen Consecutive Nights—Amateur Signals also Recorded

By J. H. D. Ridley

IT was while listening for American amateurs, in order to make final adjustment to my receiver for the coming Trans-Atlantic Tests, that I first heard the Newark station—WJZ.

On the morning of November 26th, I was tuning between 350 and 400 meters with the hope of hearing a 375-meter American amateur station, when I cut across a weak C. W. wave. At first I thought it was an amateur holding the key down, when suddenly the unmistakable signs of modulation were heard. I immediately brought the reaction coil away from the secondary and was able to just distinguish weak telephony. I retuned my set, and you can imagine my utter surprise when I heard a voice with a distinct American accent say, "The next item on our programme will be a prelude by Chopin, played on the violin and piano." This selection was then heard, and increased to such an intensity that I could hardly believe my ears when I laid the phones on the table and moved about twelve feet away where the music was as clear as could be desired.

Items then followed in quick succession, each one being clearly heard, including the announcement that "On Sunday afternoon, at 3 p. m. there would be something worth listening to." This was followed by dance music, and at 3.31 a. m. came the final announcement, "This is the Radio Corporation — Westinghouse station WJZ signing off. Good Night."

So much for WJZ. Now for the other broadcast stations.

On the 18th of December, I received another station whose call I understood as WDAM, Weston Electric Co., New York. The signals were fading badly from this station, but remained audible long enough to hear the call repeated several times, and also a pianoforte solo, and dance music played by a gramophone.

The following morning, December 19th, the station of the Kansas City *Star*, WDAF, came in with such strength, that it would easily have operated a loud speaker, had there been one available. Signals were at least three times stronger than those of WJZ.

I was only able to listen to this station for a short time, owing to the fact that the amateur tests were in progress and I was anxious not to miss any station that might get across. The following is what I heard:—

3.30 a. m. Call WDAF repeated several times.

3.33 a. m. The next selection is entitled "Childhood Days." O. K. record.

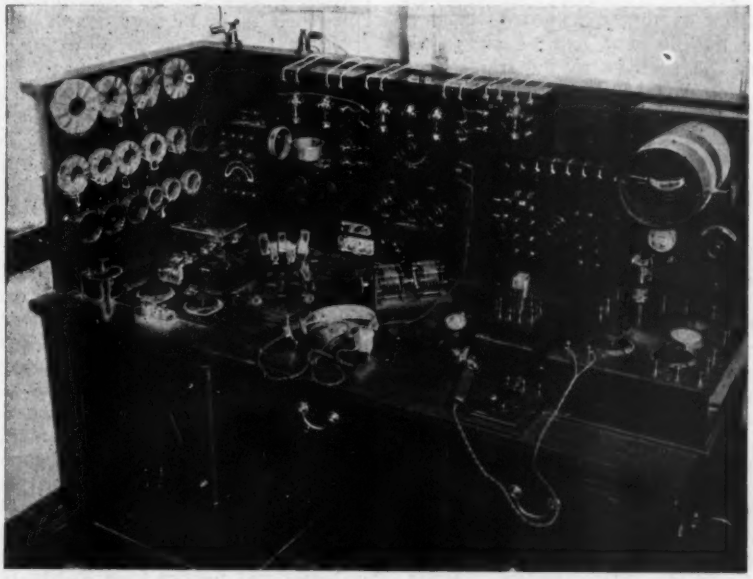
3.37 a. m. Laughing record.

3.43 a. m. Orchestral selection.

3.49 a. m. Comedian.

I listened, in all, for eighteen nights and on each of those occasions an American broadcast station was audible. This would seem to refute any suggestion of freak reception. Throughout the tests only two steps of radio frequency, a detector, and one step of audio frequency were used.

The following is a description of the set used, which may be of interest to readers:—



Receiving set used by J. H. D. Ridley of London, in the unprecedented recording of American broadcasts. The set has a range of 150 to 22,000 meters, and two steps of radio frequency amplification, a detector and one step of audio frequency were used

On this morning I also heard WGY, but the speech was too weak to understand.

I was so surprised with the strength of WDAF that I obtained a Dictaphone and records, and adapted a 2000-ohm earpiece in place of the usual mouthpiece.

Then at about 3 a. m. on December 21st. I heard WDAF coming in with such intensity that I switched over to the Dictaphone, with the result that I was able to obtain a complete permanent record of a vocal selection. Prior to this I had permanently recorded signals from American amateur station 1CMK about 1.30 a. m.

This is, I think, the first time on record that an American broadcast concert has been effectively recorded in England, or even Europe.

On the extreme left is a set of Burndept multi-layer coils, including a special short wave set, giving a range of 150 to 22,000 meters.

Underneath the coils are the tuning controls, all of which have been placed in the most accessible positions possible. The two condensers which may be seen let into the desk top, are used for "Duplex" reception. By means of these one can follow two stations working on different waves, by simply tuning a condenser to each station and throwing the single-pole double-throw switch over to whichever condenser is needed.

Behind these is a vernier condenser, which is in parallel with whichever condenser is in use; series-parallel switch; coilholder and "stand-by," "tune" switch. The coilholder is

mounted on rubber feet to minimize any trace of capacity effect.

On the back of the desk from left to right are, short wave heterodyne, two-valve R. F. tuned anode amplifier, Burndept 3-receiver (1R.F. detector 1A.F.), additional one-valve A. F. magnifier, "A" and "B" battery switchboard containing "B" battery variation switch and fuses in both circuits and a 10-watt transmitter.

This transmitter is the actual set that was used to send out 200-meter calibration waves for the benefit of amateurs competing in the tests. A record was established when signals were heard in Edinborough, a distance of 500 miles, with an antenna current of .2 amps.

The change-over from receive to transmit is done by pressing a button on a Hart push-botton switch, which is located behind the key. On pressing the first button the relay (which is seen in front of the switchboard) changes over the filament battery and aerial from the receiver to the transmitter, and also closes the low tension side of the generator. On pressing the second button the action is reversed.

The generator is driven from a Hart 12-volt 120-ampere hour storage battery, and is rated at 10 watts, delivering 10-milliamperes at 1000 volts. Radiation is in the order of .75 amps. on 200 meters. The call is 5NN.

The aerial at present in use is a single wire 180 feet long and 37 feet high. This is shortly to be replaced by a six-wire cage and a counterpoise.

Following is a list of American amateur stations that I received during the preliminary and final Trans-Atlantic tests:

1XK, 1XU, 1GV, 1OR, 1ZE, 1ARY, 1AKG, 1AZW, 1BDI, 1BDT, 1BRQ, 1CMK, 1CRW, 1XAJ, 1BES, 1BAS, 1CKG, 2FP, 2GR, 2LO, 2HJ, 2KL, 2NZ, 2LM, 2ZK, 2AWL, 2CNJ, 2CQZ, 2CWB, 3BL, 3BVL, 3XM, 3BLF, 3GE, 3YO, 3HG, 3AQR, 4OI, 4EA, 4KM, 5XK, 7ZV, 8IB, 8BK, 8ADG, 8AQO, 8XAK, 8BPL, 8ATF, 9ZN, 9LG, 9CTE.

I heard every district except sixth.

Standardizing Broadcast Market Reports

SO important has become the broadcasting of market reports, crop news, weather forecasts and lectures on general agricultural topics that the authorities in Washington are drafting plans for uniform procedure. At present, practically each broadcasting station contains in its daily program some data especially designed for the farmers, and these have been so loud in their praise and so anxious to profit by the new radio service that more and more features have been added. The sudden growth of broadcasting to the farmer, therefore, has resulted in considerable confusion in methods, somewhat handicapping listeners.

Several stations have distributed blank forms for copying market reports, but due to varying systems of reading the information, the form that is suited to one station cannot be used for another. In order that the farmer may profit fully and easily by the broadcast reports, the Bureau of Agricultural Economics, of the U. S. Department of Agriculture, is studying the possibilities of standardizing both the transmission of market and crop reports, and the blanks for copying them. Probably the standardization will be worked out on a territorial or sectional basis, as each part of the country has different interests. The cattle states, for instance, are not interested in the lumber and potato markets that are vital to Maine, nor is the dairy industry of the Northwest concerned with the cotton and sugar crops of the South.

In the near future it is expected that the work of the authorities will bear fruit in scientifically arranged programs for the farmer, which will enable him to realize to the utmost the great benefits that radio holds for him.

"Spanish Night" in Tampa

"SPANISH NIGHT" was recently observed by WDAE, radio broadcasting station of the *Tampa Times*, when a program "of and for" the Spanish-speaking people of Florida, nearby states, Cuba and the Isles of the sea, was broadcast. For this occasion the services of a number of Spanish musicians of unusual ability were secured.

The performers were Spanish people now residing in Tampa, all of whom have held enviable places in the musical world. Several numbers were given by Señor and Señora Luis Rueda, operatic singers who have sung all over Spain, South America and Cuba. Señor F. M. Grasso played flute selections, Professor Maximi Echegaray was heard in piano solos, little Luisa Rueda gave two vocal numbers, while Señor Victor Fernandez spoke what was described as a side-splitting monologue, á la Castilian. Señor Arturo Moran, baritone, and Señora Amelia Moran each gave vocal selections. A string trio was furnished by G. Moreno, R. Moreno and R. Rigau, who also played solos.

The Spanish devotees of the "listening-in-on-the-ether-waves" cult started telephoning immediately following the opening selection and continued throughout the performance. Although it was not possible for the non-Spanish telephone operator to translate all of the messages, they were quite evidently expressive of appreciative interest. Since the concert numerous written reports have also been received, indicating that the special program aroused an interest which may result in more "Spanish Nights" being put on by WDAE. At present WDAE is broadcasting each Wednesday and Friday evening, from 8 to 10 p.m.

Radio Comes to Relief of Snowbound Farmer

FARMERS who were lukewarm to radio or who looked upon it as a diversion for the women and a toy for the children, are today convinced that radio broadcasting is a real utility. New York State for example was veritably buried under twenty-six inches of snow. The cities were able to cope with the snow after a fashion but the country was practically isolated, especially after the wind churned up the snow and drifted roads as rapidly as shovelers and tractors opened them.

The farmer was snowed in. Rural mail carriers found it impossible to get through for days. In some cases the telephone lines were temporarily out of commission. Notwithstanding his isolation the farmer with a radio receiving set was able to get the news of the day; he kept in touch with market prices though he was not able to take advantage of favorable quotations and during the evening he and his entire family were entertained with music and speeches.

Broadcasters Mustn't Talk to Individuals

BROADCASTING stations that acknowledge on the air the receipt of telephone calls, telegrams and letters, giving names and addresses, are violating their licenses, according to the U. S. "Radio Service Bulletin."

"Operators of broadcasting stations are cautioned not to communicate with other stations," states the notice. "The transmission of acknowledgments to individuals relating to the receipt of letters, telegrams, and telephone calls is direct communication and not authorized in the licenses of broadcasting stations. Section 2 of the act of August 13, 1912, states that the license of a station 'shall state the purpose of the station,' and as broadcasting stations are licensed for the specific service of broadcasting, any operator using a broadcasting station for point-to-point communication may have his license suspended or revoked in the discretion of the Secretary of Commerce. Owners of broadcasting stations should see that the above-cited act is not violated, as the use of their stations for purposes other than specified in the station license is sufficient cause for the suspension or revocation of their station license."

SOS Halts Broadcasting in Metropolitan Area

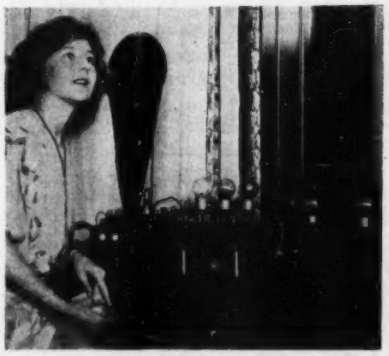
FOR the first time in its history broadcasting in New York City came to a sudden and complete silence at 8.40 p. m. on February 6, when the U. S. Navy picked up an SOS call and issued a peremptory QRT order for everybody to stop transmitting. The call for assistance came from the freighter *Winnebago*, about 800 miles off the coast of France. Twenty minutes later position reports from ships in the vicinity had been sorted out, the nearest vessel was rushing for the *Winnebago*, and air traffic in relation to the emergency had been completed. The message to resume regular operation was transmitted by the Navy, and the air once more became filled with dots, dashes and music. During the enforced silence the broadcast listeners and amateurs in the vicinity of New York enjoyed the opportunity of tuning in the distant stations inland, which remained on the air, and which are not usually heard through local interference.

Even if the Navy had not issued its order to clear the air, probably WEAF and WJZ, which were transmitting at the time, would have picked up the SOS signal and shut down of their own accord, as required by the U. S. radio laws and regulations. All coastal stations are required to "listen in at intervals of not less than 15 minutes, and for a period of not less than 2 minutes," with receiving apparatus tuned to 600 meters, the wave length on which distress signals are sent, for the purpose of determining if any such signals are being sent and to determine if they are interfering with this essential traffic.

This explains why broadcasters all along both coasts frequently announce that "our program will be continued in three minutes." Most people think that they are arranging the next number in the studio, but as a matter of fact they are not only doing that, but up in the operating room a licensed operator has his ears glued to a pair of receivers, listening to what's going on in 600 meters. In fact, WDY, the station at Roselle Park, N. J., which was one of the pioneer broadcasting stations in the Metropolitan District, frequently announced: "We will now shut down for two minutes in order to listen for distress calls, as required by the radio laws, after which our program will be continued."

The provision of the radio law requiring listening for at least two minutes out of every fifteen applies only to coast stations, which is why broadcasters further inland continued to operate after the *Winnebago* called for assistance. However, they also would be required to shut down if it should happen that they interfered with radio communication of an essential character. It is quite possible that the most powerful of them might do so, in the case of a sea disaster near the coast, and an almost complete cessation of broadcasting over half the country might result. Thousands of radio fans, who can read the code then would sit back and endeavor to tune in the signals from the scene of disaster —thrilled at the news of a great steamer in danger.

Listening at Sea



Miss Florence Dixon shown at the receiving apparatus aboard the Mauretania, one of the first ocean liners of the first-class to give their passengers the benefit of broadcast concerts

NAA on 710 Meters

ON January 3rd, Governmental broadcasting in the East was taken over by NAA, the great U. S. Navy station at Radio, Va., near Arlington. This station, by assuming the broadcasting duties of NOF, enabled the latter to give all its attention to the experimental and research work to which it was devoted prior to the development of public broadcasting.

NOF, however, may be heard on the air from time to time with voice and music, as it will experiment with telephony as well as telegraphy. NAA now works on 710 meters for broadcasting, using a special single wire antenna stretched from the top of one of the 400-foot towers, enabling broadcasting to be conducted simultaneously with telegraphy on other wave lengths. The set used puts 1.5 kw. in the antenna, using six 250-watt vacuum tubes, and so has a range of several thousand miles.

New Westinghouse Pick-up

A NEW pick-up device making use of an electrical discharge instead of a diaphragm has been in successful use at KDKA, Pittsburgh, Pa., for a number of weeks, and has proved to give such remarkably faithful reproduction of sounds of all kinds that it is being installed in all Westinghouse broadcasting stations. The new device is the invention of Dr. Phillips Thomas, research engineer, who some time ago decided that the diaphragm, with its inherent inability to respond perfectly over the entire range of sound, was the source of most of the difficulty encountered in achieving faithful reproduction. He sought to eliminate it by substituting an electrical discharge.

In the Thomas transmitter, as finally worked out, a minute electrical discharge flows between two points that are separated only a fraction of an inch. This discharge, taking place in the air, is affected by sound waves, and being non-material and having no perceptible inertia, it responds equally well to all sounds. Hence the great purity of its output to the broadcasting transmitter.

In appearance it resembles the ordinary watch-shaped microphone that is to be found in so many studios, with wire gauze filling the openings, but on peering within a point of light can be seen. This is the sensitive electrical current that is acted upon by the sound wave. Because of the visibility and construction of the device it is called the Glow-Discharge transmitter.

Pallophotophone Pick-up Used at WGY

USE of the extremely sensitive pick-up device of the Pallophotophone for broadcasting directly without the intermediary of a film, has been decided upon by WGY, and as a result listeners to that Schenectady station have noted a marked improvement in reproduction. The Pallophotophone pick-up consists of a very sensitive diaphragm, the movement of which is connected to a mirror only 3/64 of an inch square. The strong light is reflected against this mirror, which reflects a tiny beam on a sensitive cell whose resistance varies in accordance with the amount of light it receives. In this way the vibrations of the diaphragm, in accordance with the voice or music that fill the air in its vicinity, are caused to vary the electric circuit going to the amplifier in the broadcasting studio.

It has been found in practice that this new method is much more sensitive than others, responding more readily and more accurately and capturing harmonics that otherwise would be lost. The system is very tiny, which probably has a great deal to do with its sensitiveness. The diaphragm and mirror together weigh only 1/10 of a gram, or half as much as the head of a common pin. It has proved so successful in use that it is now a permanent part of the studio equipment at WGY.

Distant Broadcasting Stations Heard

Broadcasting fans daily surprise themselves and others by reaching out across hundreds of miles by a turn of the wrist. Often the most simple bulb equipment will produce astonishing results, as reported below. What have YOU done?

HAYMOND MAXWELL, JR., Clarksburg, W. Va., besides hearing everybody within five hundred miles with his detector and one step, has heard the following more distant stations:

		Miles
WBAP	Fort Worth, Tex.	1,100
WFAA	Dallas, Tex.	1,075

GERRIT VAN DE KAMP, Pella, Iowa, who operates amateur station 9BUL, has heard the following broadcasters on one bulb:

		Miles
WJZ	Newark, N. J.	1,000
WOR	Newark, N. J.	1,000
KGN	Portland, Ore.	1,600
WGY	Schenectady, N. Y.	1,000
CFCN	Calgary, Alta.	1,200
KHO	Seattle, Wash.	1,500
WWZ	New York City	1,000
WRW	Tarrytown, N. Y.	1,000
KHJ	Los Angeles, Cal.	1,500
2XI	Schenectady, N. Y.	1,000

WILLIAM HENDERSON, Clinton, Iowa, using a single circuit tuner and detector, heard the following stations:

		Miles
KHJ	Los Angeles, Cal.	1,600
PWX	Havana, Cuba	1,550
WAAJ	Boston, Mass.	1,000
WOAI	San Antonio, Tex.	1,000

AINSWORTH MOORE, Spiro, Okla., is enjoying his detector and one step these nights, listening to the following stations:

		Miles
WGY	Schenectady, N. Y.	1,220
KFI	Los Angeles, Cal.	1,350
KHJ	Los Angeles, Cal.	1,350
KWH	Los Angeles, Cal.	1,350
WBAY	New York, N. Y.	1,210
WOR	Newark, N. J.	1,200
WJZ	Newark, N. J.	1,200
PWX	Havana, Cuba	1,125
CFAC	Calgary, Alta., Can.	1,500
KDYL	Salt Lake City, Utah	1,000
KLN	Salt Lake City, Utah	1,000
WGR	Buffalo, N. Y.	1,000
WIP	Philadelphia, Pa.	1,140
KDYS	Great Falls, Mont.	1,200
KFDB	San Francisco, Cal.	1,580

THOMAS W. BALE, Saugerties, N. Y., says he is "real proud" of his distance work:

		Miles
PWX	Havana, Cuba,	1,250
KFZ	Spokane, Wash.	1,900
WPA	Fort Worth, Tex.	1,450

LAWRENCE HOLT, Independence, Kansas, who is fifteen years old, made himself a regenerative set and has heard the following stations:

		Miles
KHJ	Los Angeles, Cal.	1,275
PWX	Havana, Cuba	1,250
WGY	Schenectady, N. Y.	1,200
WOR	Newark, N. J.	1,200
WJZ	Newark, N. J.	1,200

JACK A. CARVAN and LLOYD HANSEN, Bozeman, Mont., have heard the following stations on one bulb:

		Miles
WOC	Davenport, Iowa	1,100
WHB	Kansas City, Mo.	950
WBAP	Fort Worth, Tex.	1,125
WSB	Atlanta, Ga.	1,600
WWJ	Detroit, Mich.	1,400

THEODORE SMITH, Clear Lake, Wash., has heard 115 broadcasters, although his town is supposed to be in a locality unfavorable to radio reception. Among the 115 are:

		Miles
KSD	St. Louis, Mo.	1,700
WOC	Davenport, Iowa	1,600
WGY	Schenectady, N. Y.	2,375
WBAP	Fort Worth, Tex.	1,600
WHB	Kansas City, Mo.	1,550

A. H. BECKER, Madison, Wis., joins the ranks of DX fans using crystal detectors, with the following list:

		Miles
WFAA	Dallas, Tex.	850
WGY	Schenectady, N. Y.	800
KDKA	Pittsburgh, Pa.	500
WHAZ	Troy, N. Y.	825

E. F. KINGRIE, Bridgeport, Conn., uses a single circuit tuner and detector bulb to hear many distant stations:

		Miles
WOC	Davenport, Iowa	1,500
PWX	Havana, Cuba	1,800
WKAQ	San Juan, Porto Rico	2,000
WSB	Atlanta, Ga.	1,000
WGM	Atlanta, Ga.	1,000

DAN GIROUX, Waterville, Me., has heard the following stations on a single tube:

		Miles
KYW	Chicago, Ill.	1,000
WGM	Atlanta, Ga.	1,100
WHA	Madison, Wis.	1,100
WHB	Kansas City, Mo.	1,400
WOC	Davenport, Ia.	1,100
WAAZ	Emporia, Kans.	1,500
WHAS	Louisville, Ky.	1,000
WNAF	Enid, Okla.	1,700
PWX	Havana, Cuba	1,700

GEO. B. RANDALL, M.D., Albany, N. Y., used all three tubes until he heard of the possibilities of the detector alone. He reports hearing the following on one tube:

		Miles
WHB	Kansas City, Mo.	1,100

EDWARD C. GILL, an early record holder in these pages, enjoyed the Christmas holidays at Earlysville, Va., with a single tube set, and in a week heard everything except the Pacific Coast.

		Miles
WKY	Oklahoma City, Okla.	1,000
WPA	Fort Worth, Tex.	1,150
WDAO	Dallas, Tex.	1,100
WBAP	Fort Worth, Tex.	1,150
PWX	Havana, Cuba	1,125

STANLEY L. BATEMAN, Philadelphia, Pa., has a regenerative set with two stages of amplification and has heard 31 stations, some of which are:

		Miles
WMAM	Beaumont, Tex.	1,450
WFAC	Superior, Wis.	1,000

DOYLE KELLER, Rupert, Idaho, uses a detector and two stages, tunes in every station within a thousand miles, and these as well:

		Miles
PWX	Havana, Cuba	2,300
WSB	Atlanta, Ga.	1,700
WJZ	Newark, N. J.	2,100
KYW	Chicago, Ill.	1,300
WCX	Detroit, Mich.	1,550

VIRGIL AND VINAL COX, Wauseon, O., take great pride in a long list of stations heard between 500 and 1,000 miles distant, and the following further off still:

		Miles
KRE	Berkeley, Cal.	2,050
WBAP	Fort Worth, Tex.	1,000
WGAD	Ensonado, P. R.	2,000
KZM	Oakland, Cal.	2,000
KYF	San Diego, Cal.	1,950
WDAH	El Paso, Tex.	1,375
PWX	Havana, Cuba	1,400
KDZU	Denver, Col.	1,075
KNI	Eureka, Cal.	1,950
KOB	State College, N. M.	1,250
KYY	San Francisco, Cal.	2,000
KJJ	Sunnyville, Cal.	2,000
KJS	Los Angeles, Cal.	1,950
KAO	Denver, Col.	1,075
KLZ	Denver, Col.	1,075
KDZA	Tucson, Ariz.	1,575
KGW	Portland, Ore.	1,925
WOAI	San Antonio, Tex.	1,100

EDGAR SMITH, Alliance, O., says he has a peanut tube set with one stage of amplification, and uses the bed spring for antenna, hearing 95 stations in one month.

		Miles
CJNC	Winnipeg, Man., Canada	1,035
WKAH	West Palm Beach, Fla.	1,035
WCAK	Houston, Tex.	1,150
WFAA	Dallas, Tex.	1,100
KON	San Diego, Cal.	2,200
KUY	El Monte, Cal.	2,100
KWH	Los Angeles, Cal.	2,100
KFDB	San Francisco, Cal.	2,300
KFC	Seattle, Wash.	2,250
KGG	Portland, Ore.	2,200

CHARLIE HAILMAN, Kingsburg, Cal., writes that his "first month of operating a single tube set was fine." He heard 36 stations in 11 states, among them:

		Miles
KSD	St. Louis, Mo.	1,650
WDAF	Kansas City, Mo.	1,400
WHB	Kansas City, Mo.	1,400

EDWIN W. PITCHER, Chicago, Ill., has to wait until midnight to do DX work with his two-step amplifier.

		Miles
KFDB	San Francisco, Cal.	1,800
KHJ	Los Angeles, Cal.	1,700
KFDF	Casper, Wyo.	1,000
WOAI	San Antonio, Tex.	1,000

JOSEPH A. WRIGHT, Winnipeg, Man., Canada, finds winter weather with the thermometer 20 below fine for receiving. He hears 70 stations, some of them over 600 miles away, on a crystal, and many more on a tube.

		Miles
KQI	Berkeley, Cal.	1,400
KDKA	Pittsburgh, Pa.	1,075
WGY	Schenectady, N. Y.	1,200
WBAP	Fort Worth, Tex.	1,200
WPA	Fort Worth, Tex.	1,200
KHJ	Los Angeles, Cal.	1,550

W. MILLER, Dallas, Tex., says: "I claim no record, I merely submit this as why I am proud of my set," which is a single-circuit tuner using detector only.

		Miles
KHJ	Los Angeles, Cal.	1,200
KDPT	San Diego, Cal.	1,200
WMAT	Duluth, Minn.	1,050
WJAP	Duluth, Minn.	1,050
WEAF	New York City	1,550
WGY	Schenectady, N. Y.	1,500
KDKA	Pittsburgh, Pa.	1,150
KZN	Salt Lake City, Utah	1,050
KFCF	Walla Walla, Wash.	1,750
WFAC	Superior, Wis.	1,100
CKCK	Regina, Sask., Canada	1,450
CKCD	Vancouver, B. C., Canada	1,825
WWJ	Detroit, Mich.	1,000
WDAY	Fargo, N. D.	1,000
WTP	Bay City, Mich.	1,000

HAROLD A. OLSEN, Berkeley, Cal., made a tuner at a cost of $3, having to buy only the wire, switches and binding posts. It works!

		Miles
CFCN	Calgary, Alta., Canada	1,000

ROBERT F. MERRILL, Toronto, Canada, using a single Mullard tube, of English make, hears a great many Canadian and American broadcasters, and also some amateurs, such as 9YY, at Lincoln, Neb., 1,000 miles away.

		Miles
CJNC	Winnipeg, Man., Canada	1,000

L. A. NEUMANN, Locust Valley, N. Y., has a simple single-tube receiver that operates a Victrola phonograph attachment when picking up nearby stations.

		Miles
WBAP	Fort Worth, Tex.	1,500
PWX	Havana, Cuba	1,400
WHB	Kansas City, Mo.	1,150
WDAF	Kansas City, Mo.	1,150

RICHARD SIMODYNES, Wahoo, Neb., likes his non-regenerative tuner and one-step amplifier because it brings in a lot of stations, among them:

		Miles
WGY	Schenectady, N. Y.	1,000
WJZ	Newark, N. J.	1,000
KFFA	San Diego, Cal.	1,300
KFAW	Santa Ana, Cal.	1,400

ALLAN R. BROWN, Cedar Falls, Ia., has received over 90 stations with two stages of amplification, including both coasts.

		Miles
KHJ	Los Angeles, Cal.	1,500
KFI	Los Angeles, Cal.	1,500
KWH	Los Angeles, Cal.	1,500
WJZ	Newark, N. J.	1,000
WGY	Schenectady, N. Y.	1,000
KMJ	Fresno, Cal.	1,500

SHERWOOD BARNES, Forest Hills, N. Y., uses a single detector tube in a regenerative circuit, and hears most of the Eastern stations.

		Miles
WHAN	Wichita, Kans.	1,200

The following readers have submitted lists showing stations heard over a distance of less than 1,000 miles:

I. F. LAWMAN, Clarksburg, W. Va.
JACK HELIBERG, Montpelier, Ind.
DWIGHT MARTIN CHEEVER (age 10), Chicago, Ill.
EUGENE SULLIVAN, Atchison, Kans.
DAVID B. HEXTER, New York City.

When Ether Waves Run Wild

Our Egyptian Expedition

AT great cost and expense we have sent a corps of trained excavators to Egypt. Their researches have been crowned with success. The tomb of Tutt-Tutt-Sta-Tic was discovered, and proved to be the richest find ever found. It throws great light on the hopes and aspirations, the loves and hates, of those Phara-off days. The preliminary report from our diggers lists the following contents of the tomb:

WIRE. Made of solid gold. A porcelain object attached at each end, and fragments of rope also tied to the porcelain. Use unknown. Length 100 feet.

KNOBS. Solid ivory. Mysterious lines at the edge, with characters meaning, as near as can be deciphered, the numerals 10, 20 and so on to 180.

BOX. Of cedar, lined with gold leaf. Reason for placing the decoration inside unknown. The box has numerous holes evidently drilled with great care but without any apparent plan or purpose.

TOOL. Evidently a drill. Made of Schwab iron and Carnegie steel. Lettered: "Red D-vil H-nd D-ill."

ANOTHER. A blob of copper (Chile Cons.) on a rod. When found was still hot.

AGAIN. Head of a goat with long horns, on a stick. Excavator mashed his thumb with it. Evidently an object connected with religious rites, presumably used when appealing to the god Ouch-Dam-Mit.

DITTO: Straight rod, flattened to a blunt edge at the end. Stamped "Cast steel, Mechanics No. 12A1776."

WIRE MUMMY. Copper wire, carefully wrapped in two layers of cotton. Gauge of wire, No. 24. Unique, and an unparalleled discovery. Indications that King Tutt's undertaker had discovered how to mummify wire.

CYLINDER. Apparently of cardboard soaked in wax. A few loose coils of wire wound around it. Beside it were found two square rods of platinum with solid gold blocks sliding over them. Each block bore a flat steel spring.

CRYSTAL. Pure diamond, in gold box marked "Tested NAA."

CAT. Mummified. Frequently found in Egyptian tombs, but the head of this one had been unwrapped and all its whiskers pulled out.

BOTTLES. Clear glass. Each held in a brass stand with four legs. One marked "UV-200," and the other "C-300." Otherwise identical. Contain wires and elements and things. No stopper provided by which these can be taken out, so use is unknown. One was dropped accidentally, whereupon it exploded with a loud report. Fortunately no one was injured. Probably an implement of legal warfare.

SAFE. Black, made of ebony with gold and platinum trimmings. Very heavy. Marked "120 A.H." At first appearance, a treasure chest, but when opened it contained nothing but some lead plates in the Egyptian national colors, red and gray, immersed in sulphuric acid.

PAPYRUS. Manuscript, worn to a frazzle by constant use. Cover missing. Evidently a list of the King's slaves, who bore numbers starting with "1AA" and ending with "9ZK."

CARTON. Yellow and brown papyrus, bearing the figure of a camel walking a mile. Contents, small papyrus cylinders containing fragments of a fragrant herb. Evidently incense.

CLICKER. Made of solid gold, with platinum trimmings. A lever with a solid ivory knob on one end and a spring underneath, so as to keep it raised. Makes a loud click when the knob is pressed down. Used for secret communication. Inscriptions on the tomb show that the populace arose in rebellion against the abuse of this device and appealed to the High Priest, Hoo-Ver, saying that they wanted all sounds uttered in plain Egyptian, so all could understand. History does not record the outcome of this rebellion, and it is hoped that further exploration in King Tutt-Tutt-Sta-Tic's tomb will clear up this dark spot in Egyptian history. —S. W.

ON THE FARM

—Philadelphia Public Ledger

Wise Crack-les

Hello!

O. M. reports that when he asked a Neighborly Telephone operator to listen in the first thing she heard was an amateur calling "Hello, hello" in a very fuzzy voice. Whereupon the N. T. O. responded in a sweet voice: "The lii-ine is busy," and then blushed prettily.

She "Nose"

Margie—And he had radio eyes!

Sue—What do you mean, radio eyes?

Margie—Oh, just eyes with a broad cast!—*Crosley Weekly.*

Operatic

Rheo: "I sure like this opera Carmen."

Stat: "Whaddye mean, that ain't Carmen, that's Rigoletto. They don't broadcast Carmen until next Thursday."

Rheo (reaching for the dial): "Wonder if I can get somethin' else?"

Why We Need Secret Radio

When the girls get to sending their kisses by radio, they mustn't be too particular who all tunes in on them.—Kansas City *Star.*

Distant Broadcasting Stations Heard

Broadcasting fans daily surprise themselves and others by reaching out across hundreds of miles by a turn of the wrist. Often the most simple bulb equipment will produce astonishing results, as reported below. What have YOU done?

HAYMOND MAXWELL, JR., Clarksburg, W. Va., besides hearing everybody within five hundred miles with his detector and one step, has heard the following more distant stations:

		Miles
WBAP	Fort Worth, Tex.	1,100
WFAA	Dallas, Tex.	1,075

GERRIT VAN DE KAMP, Pella, Iowa, who operates amateur station 9BUL, has heard the following broadcasters on one bulb:

		Miles
WJZ	Newark, N. J.	1,000
WOR	Newark, N. J.	1,000
KGN	Portland, Ore.	1,600
WGY	Schenectady, N. Y.	1,000
CFCN	Calgary, Alta.	1,200
KHO	Seattle, Wash.	1,500
WWZ	New York City	1,000
WRW	Tarrytown, N. Y.	1,000
KHJ	Los Angeles, Cal.	1,500
2XI	Schenectady, N. Y.	1,000

WILLIAM HENDERSON, Clinton, Iowa, using a single circuit tuner and detector, heard the following stations:

		Miles
KHJ	Los Angeles, Cal.	1,600
PWX	Havana, Cuba	1,550
WAAJ	Boston, Mass.	1,000
WOAI	San Antonio, Tex.	1,000

AINSWORTH MOORE, Spiro, Okla., is enjoying his detector and one step these nights, listening to the following stations:

		Miles
WGY	Schenectady, N. Y.	1,220
KFI	Los Angeles, Cal.	1,350
KHJ	Los Angeles, Cal.	1,350
KWH	Los Angeles, Cal.	1,350
WBAY	New York, N. Y.	1,210
WOR	Newark, N. J.	1,200
WJZ	Newark, N. J.	1,200
PWX	Havana, Cuba	1,125
CFAC	Calgary, Alta., Can.	1,500
KDYL	Salt Lake City, Utah	1,000
KLN	Salt Lake City, Utah	1,000
WGR	Buffalo, N. Y.	1,000
WIP	Philadelphia, Pa.	1,140
KDYS	Great Falls, Mont.	1,200
KFDB	San Francisco, Cal.	1,580

THOMAS W. BALE, Saugerties, N. Y., says he is "real proud" of his distance work:

		Miles
PWX	Havana, Cuba,	1,250
KFZ	Spokane, Wash.	1,900
WPA	Fort Worth, Tex.	1,450

LAWRENCE HOLT, Independence, Kansas, who is fifteen years old, made himself a regenerative set and has heard the following stations:

		Miles
KHJ	Los Angeles, Cal.	1,275
PWX	Havana, Cuba	1,250
WGY	Schenectady, N. Y.	1,200
WOR	Newark, N. J.	1,200
WJZ	Newark, N. J.	1,200

JACK A. CARVAN and LLOYD HANSEN, Bozeman, Mont., have heard the following stations on one bulb:

		Miles
WOC	Davenport, Iowa	1,100
WHB	Kansas City, Mo.	950
WBAP	Fort Worth, Tex.	1,125
WSB	Atlanta, Ga.	1,600
WWJ	Detroit, Mich.	1,400

THEODORE SMITH, Clear Lake, Wash., has heard 115 broadcasters, although his town is supposed to be in a locality unfavorable to radio reception. Among the 115 are:

		Miles
KSD	St. Louis, Mo.	1,700
WOC	Davenport, Iowa	1,600
WGY	Schenectady, N. Y.	2,375
WBAP	Fort Worth, Tex.	1,600
WHB	Kansas City, Mo.	1,550

A. H. BECKER, Madison, Wis., joins the ranks of DX fans using crystal detectors, with the following list:

		Miles
WFAA	Dallas, Tex.	850
WGY	Schenectady, N. Y.	800
KDKA	Pittsburgh, Pa.	500
WHAZ	Troy, N. Y.	825

E. F. KINGRIE, Bridgeport, Conn., uses a single circuit tuner and detector bulb to hear many distant stations:

		Miles
WOC	Davenport, Iowa	1,500
PWX	Havana, Cuba	1,800
WKAQ	San Juan, Porto Rico	2,000
WSB	Atlanta, Ga.	1,000
WGM	Atlanta, Ga.	1,000

DAN GIROUX, Waterville, Me., has heard the following stations on a single tube:

		Miles
KYW	Chicago, Ill.	1,000
WGM	Atlanta, Ga.	1,100
WHA	Madison, Wis.	1,100
WHB	Kansas City, Mo.	1,400
WOC	Davenport, Ia.	1,100
WAAZ	Emporia, Kans.	1,500
WHAS	Louisville, Ky.	1,000
WNAF	Enid, Okla.	1,700
PWX	Havana, Cuba	1,700

GEO. B. RANDALL, M.D., Albany, N. Y., used all three tubes until he heard of the possibilities of the detector alone. He reports hearing the following on one tube:

		Miles
WHB	Kansas City, Mo.	1,100

EDWARD C. GILL, an early record holder in these pages, enjoyed the Christmas holidays at Earlysville, Va., with a single tube set, and in a week heard everything except the Pacific Coast.

		Miles
WKY	Oklahoma City, Okla.	1,000
WPA	Fort Worth, Tex.	1,150
WDAO	Dallas, Tex.	1,100
WBAP	Fort Worth, Tex.	1,150
PWX	Havana, Cuba	1,125

STANLEY L. BATEMAN, Philadelphia, Pa., has a regenerative set with two stages of amplification and has heard 31 stations, some of which are:

		Miles
WMAM	Beaumont, Tex.	1,450
WFAC	Superior, Wis.	1,000

DOYLE KELLER, Rupert, Idaho, uses a detector and two stages, tunes in every station within a thousand miles, and these as well:

		Miles
PWX	Havana, Cuba	2,300
WSB	Atlanta, Ga.	1,700
WJZ	Newark, N. J.	2,100
KYW	Chicago, Ill.	1,300
WCX	Detroit, Mich.	1,550

VIRGIL AND VINAL COX, Wauseon, O., take great pride in a long list of stations heard between 500 and 1,000 miles distant, and the following further off still:

		Miles
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WBAP	Fort Worth, Tex.	1,000
WGAD	Ensonado, P. R.	2,000
KZM	Oakland, Cal.	2,000
KYF	San Diego, Cal.	1,950
WDAH	El Paso, Tex.	1,375
PWX	Havana, Cuba	1,400
KDZU	Denver, Col.	1,075
KNI	Eureka, Cal.	1,950
KOB	State College, N. M.	1,250
KYY	San Francisco, Cal.	2,000
KJJ	Sunnyville, Cal.	2,000
KJS	Los Angeles, Cal.	1,950
KAO	Denver, Col.	1,075
KLZ	Denver, Col.	1,075
KDZA	Tucson, Ariz.	1,575
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		Miles
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WKAH	West Palm Beach, Fla.	1,035
WCAK	Houston, Tex.	1,150
WFAA	Dallas, Tex.	1,100
KON	San Diego, Cal.	2,200
KUY	El Monte, Cal.	2,100
KWH	Los Angeles, Cal.	2,100
KFDB	San Francisco, Cal.	2,300
KFC	Seattle, Wash.	2,250
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CHARLIE HAILMAN, Kingsburg, Cal., writes that his "first month of operating a single tube set was fine." He heard 36 stations in 11 states, among them:

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WHB	Kansas City, Mo.	1,400

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WBAP	Fort Worth, Tex.	1,200
WPA	Fort Worth, Tex.	1,200
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W. MILLER, Dallas, Tex., says: "I claim no record, I merely submit this as why I am proud of my set," which is a single-circuit tuner using detector only.

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KDPT	San Diego, Cal.	1,200
WMAT	Duluth, Minn.	1,050
WJAP	Duluth, Minn.	1,050
WEAF	New York City	1,550
WGY	Schenectady, N. Y.	1,500
KDKA	Pittsburgh, Pa.	1,150
KZN	Salt Lake City, Utah	1,050
KFCF	Walla Walla, Wash.	1,750
WFAC	Superior, Wis.	1,100
CKCK	Regina, Sask., Canada	1,450
CKCD	Vancouver, B. C., Canada	1,825
WWJ	Detroit, Mich.	1,000
WDAY	Fargo, N. D.	1,000
WTP	Bay City, Mich.	1,000

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L. A. NEUMANN, Locust Valley, N. Y., has a simple single-tube receiver that operates a Victrola phonograph attachment when picking up nearby stations.

		Miles
WBAP	Fort Worth, Tex.	1,500
PWX	Havana, Cuba	1,400
WHB	Kansas City, Mo.	1,150
WDAF	Kansas City, Mo.	1,150

RICHARD SIMODYNES, Wahoo, Neb., likes his non-regenerative tuner and one-step amplifier because it brings in a lot of stations, among them:

		Miles
WGY	Schenectady, N. Y.	1,000
WJZ	Newark, N. J.	1,000
KFFA	San Diego, Cal.	1,300
KFAW	Santa Ana, Cal.	1,400

ALLAN R. BROWN, Cedar Falls, Ia., has received over 90 stations with two stages of amplification, including both coasts.

		Miles
KHJ	Los Angeles, Cal.	1,500
KFI	Los Angeles, Cal.	1,500
KWH	Los Angeles, Cal.	1,500
WJZ	Newark, N. J.	1,000
WGY	Schenectady, N. Y.	1,000
KMJ	Fresno, Cal.	1,500

SHERWOOD BARNES, Forest Hills, N. Y., uses a single detector tube in a regenerative circuit, and hears most of the Eastern stations.

		Miles
WHAN	Wichita, Kans.	1,300

The following readers have submitted lists showing stations heard over a distance of less than 1,000 miles:

I. F. LAWMAN, Clarksburg, W. Va.
JACK HELIBRER, Montpelier, Ind.
DWIGHT MARTIN CHEEVER (age 10), Chicago, Ill.
EUGENE SULLIVAN, Atchison, Kans.
DAVID B. HEXTER, New York City.

When Ether Waves Run Wild

Our Egyptian Expedition

AT great cost and expense we have sent a corps of trained excavators to Egypt. Their researches have been crowned with success. The tomb of Tutt-Tutt-Sta-Tic was discovered, and proved to be the richest find ever found. It throws great light on the hopes and aspirations, the loves and hates, of those Phara-off days. The preliminary report from our diggers lists the following contents of the tomb:

WIRE. Made of solid gold. A porcelain object attached at each end, and fragments of rope also tied to the porcelain. Use unknown. Length 100 feet.

KNOBS. Solid ivory. Mysterious lines at the edge, with characters meaning, as near as can be deciphered, the numerals 10, 20 and so on to 180.

BOX. Of cedar, lined with gold leaf. Reason for placing the decoration inside unknown. The box has numerous holes evidently drilled with great care but without any apparent plan or purpose.

TOOL. Evidently a drill. Made of Schwab iron and Carnegie steel. Lettered: "Red D-vil H-nd D-ill."

ANOTHER. A blob of copper (Chile Cons.) on a rod. When found was still hot.

AGAIN. Head of a goat with long horns, on a stick. Excavator mashed his thumb with it. Evidently an object connected with religious rites, presumably used when appealing to the god Ouch-Dam-Mit.

DITTO: Straight rod, flattened to a blunt edge at the end. Stamped "Cast steel, Mechanics No. 12A1776."

WIRE MUMMY. Copper wire, carefully wrapped in two layers of cotton. Gauge of wire, No. 24. Unique, and an unparalleled discovery. Indications that King Tutt's undertaker had discovered how to mummify wire.

CYLINDER. Apparently of cardboard soaked in wax. A few loose coils of wire wound around it. Beside it were found two square rods of platinum with solid gold blocks sliding over them. Each block bore a flat steel spring.

CRYSTAL. Pure diamond, in gold box marked "Tested NAA."

CAT. Mummified. Frequently found in Egyptian tombs, but the head of this one had been unwrapped and all its whiskers pulled out.

BOTTLES. Clear glass. Each held in a brass stand with four legs. One marked "UV-200," and the other "C-300." Otherwise identical. Contain wires and elements and things. No stopper provided by which these can be taken out, so use is unknown. One was dropped accidentally, whereupon it exploded with a loud report. Fortunately no one was injured. Probably an implement of legal warfare.

SAFE. Black, made of ebony with gold and platinum trimmings. Very heavy. Marked "120 A.H." At first appearance, a treasure chest, but when opened it contained nothing but some lead plates in the Egyptian national colors, red and gray, immersed in sulphuric acid.

PAPYRUS. Manuscript, worn to a frazzle by constant use. Cover missing. Evidently a list of the King's slaves, who bore numbers starting with "1AA" and ending with "9ZK."

CARTON. Yellow and brown papyrus, bearing the figure of a camel walking a mile. Contents, small papyrus cylinders containing fragments of a fragrant herb. Evidently incense.

CLICKER. Made of solid gold, with platinum trimmings. A lever with a solid ivory knob on one end and a spring underneath, so as to keep it raised. Makes a loud click when the knob is pressed down. Used for secret communication. Inscriptions on the tomb show that the populace arose in rebellion against the abuse of this device and appealed to the High Priest, Hoo-Ver, saying that they wanted all sounds uttered in plain Egyptian, so all could understand. History does not record the outcome of this rebellion, and it is hoped that further exploration in King Tutt-Tutt-Sta-Tic's tomb will clear up this dark spot in Egyptian history. —S. W.

ON THE FARM

—Philadelphia Public Ledger

Wise Crack-les

Hello!

O. M. reports that when he asked a Neighborly Telephone operator to listen in the first thing she heard was an amateur calling "Hello, hello" in a very fuzzy voice. Whereupon the N. T. O. responded in a sweet voice: "The lii-ine is busy," and then blushed prettily.

She "Nose"

Margie—And he had radio eyes!

Sue—What do you mean, radio eyes?

Margie—Oh, just eyes with a broad cast!—*Crosley Weekly.*

Operatic

Rheo: "I sure like this opera Carmen."

Stat: "Whaddye mean, that ain't Carmen, that's Rigoletto. They don't broadcast Carmen until next Thursday."

Rheo (reaching for the dial): "Wonder if I can get somethin' else?"

Why We Need Secret Radio

When the girls get to sending their kisses by radio, they mustn't be too particular who all tunes in on them.—Kansas City *Star.*

When Wireless Waves Whirl Wittily

SNOODLES By HUNGERFORD

LOOKS LIKE A DANDY CONCERT PROGRAM TONIGHT
HOLY CATS! THE RECEIVERS HAVE BEEN REMOVED!
PERHAPS I CAN BORROW JOHN MUNHALL'S — HE'S KIND AND GENEROUS!
SEE POP? KID ADDISON'S GOT EAR MUFFS TOO!

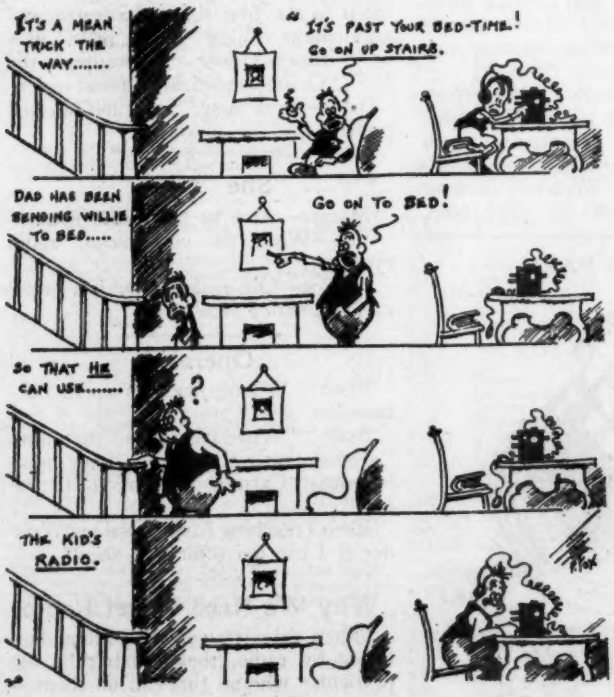
N. Y. Evening Mail

FRECKLES AND HIS FRIENDS By BLOSSER

FOR THE LIFE OF ME I CAN'T UNDERSTAND HOW THE HUMAN VOICE CAN BE HEARD FOR MILES AND MILES WITH NO WIRES.
GEE WHIZ — DON'T YOU KNOW, POP? SHUCKS! THAT'S EASY.
YSEE ITS A MAGNETIC WAVE RADIATED FROM A TRANSMITTER AERIAL WHICH INDUCES RADIO OSCILLATIONS OF FULL AMPLITUDE INTO ANOTHER RECEIVING AERIAL WHICH HAS TO BE ELECTRICALLY TUNED TO TH' FREQUENCY OF TH' TRANSMITTED RADIATED WAVE
WHAT'S TH' MATTER, POP?

Parkersburg, W. Va., Sentinel

FAMILY STUFF By FONTAINE FOX


IT'S A MEAN TRICK THE WAY.....
"IT'S PAST YOUR BED-TIME! GO ON UP STAIRS.
DAD HAS BEEN SENDING WILLIE TO BED.....
GO ON TO BED!
SO THAT HE CAN USE.....
?
THE KID'S RADIO.

N. Y. Globe

WHEN A FELLER NEEDS A FRIEND By BRIGGS

N. Y. Tribune

BROADCASTING STATION DIRECTORY

(Revised to February 20th, 1923)

Class B stations, broadcasting on 400 meters, are designated by ★

KAO Young Men's Christian Association..Denver, Colo
KDN Lee U. Meyerberg Co.....San Francisco, Calif.
★KFI E. C. Anthony.....Los Angeles, Calif.
KFV Foster Bradbury Radio Store....Yakima, Wash.
KFZ Doerr Mitchell Elec. Co.....Spokane, Wash.
KGB Wm. A. Mullins Electric Co....Tacoma, Wash.
KGG Hallock & Watson Radio Service..Portland, Ore.
KGN Northwestern Radio Mfg. Co.....Portland, Ore.
KGO Altadena Radio Laboratory.....Altadena, Calif.
KGU M. A. Muirony.....Honolulu, Hawaii
★KGW Oregonian Publishing Co. .....Portland, Ore.
KGY St. Martin's College.....Lacey, Wash.
KHD Aldrich Marble & Granite Co., Colorado Springs, Colo
★KHJ Times Mirror Co.....Los Angeles, Calif.
KHQ Louis Wasmer .....Seattle, Wash.
KJJ The Radio Shop.....Sunnyvale, Calif.
KJQ C. O. Geuld.....Stockton, Calif.
KJR Vincent I. Kraft.....Seattle, Wash.
KJS Bible Institute of Los Angeles, Inc., Los Angeles, Calif.
KLB J. J. Dunn & Co.....Pasadena, Calif.
KLN Naggie Electric Works.....Monterey, Calif.
KLP Colin B. Kennedy Co.....Los Altos, Calif.
KLS Warner Brothers .....Oakland, Calif.
KLX Tribune Publishing Co.....Oakland, Calif.
KLZ Reynolds Radio Co.....Denver, Colo.
KMC Lindsay-Wetherill & Co.....Readlay, Calif.
KMJ San Joaquin Light & Power Co...Fresno, Calif.
KMO Love Electric Co.....Tacoma, Wash.
KNI T. W. Smith.....Eureka, Calif.
KNJ Roswell Public Service Co.....Roswell, N. M.
KNN Bullok's .....Los Angeles, Calif.
KNT North Coast Products Co.....Aberdeen, Wash.
KNV Radio Supply Co.....Los Angeles, Calif.
KOA Y. M. C. A.....Denver, Colo.
KOB New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex.
KOG Western Radio Electric Co...Los Angeles, Calif.
KOH Heinemann, Inc.....San Diego, Calif.
KOP Detroit Police Dept.....Detroit, Mich.
KOQ Modesto Evening News.....Modesto, Calif.
★KPO Hale Brothers.....San Francisco, Calif.
KQI University of California.....Berkeley, Calif.
KQP Blue Diamond Electric Co....Hoel River, Ore.
KQV Doubleday-Hill Electric Co.....Pittsburgh, Pa.
KRW Charles D. Herrold.....San Jose, Calif.
KRY Stubbs Electric Co.....Portland, Ore.
KRE Maxwell Electric Co.....Berkeley, Calif.
★KSD Post Dispatch .....St. Louis, Mo.
KSL The Emporium .....San Francisco, Calif.
KUS Frost & Dean Radio Rsch. Lab..Long Beach, Cal.
KTW First Presbyterian Church.....Seattle, Wash.
KUO The Examiner Printing Co....San Francisco, Cal.
KUS City Dye Works & Laundry Co..Los Angeles, Cal.
KUY Coast Radio Co.....Del Monte, Calif.
KWG Portable Wireless Telephone Co...Stockton, Calif.
KWH Los Angeles Examiner.....Los Angeles, Calif.
KXD Herald Publishing Co.....Modesto, Calif.
KXB Braun Corporation .....Los Angeles, Calif.
KYI Alfred Harrell .....Bakersfield, Calif.
KYJ Leo J. Meyberg Co.....Los Angeles, Calif.
KYQ Electric Shop .....Honolulu, T. H.
★KYW Westinghouse Electric & Mfg. Co...Chicago, Ill.
KZM Preston, D. Allen.....Oakland, Calif.
KZN The Desert News.....Salt Lake City, Utah
KZV Wenatchee Battery & Motor Co., Wenatchee, Wash.
★KDKA Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.
KDPT Southern Electric Co.....San Diego, Calif.
KDYL Telegram Publishing Co...Salt Lake City, Utah
KDYM Savoy Theatre .....San Diego, Calif.
KDYQ Oregon Institute of Technology...Portland, Ore.
KDYS The Tribune, Inc.....Great Falls, Mont.
KDYV Cope & Cornwell Co.....Salt Lake City, Utah
KDYW Smith Hughes & Co.....Phoenix, Ariz.
KDYX Star Bulletin Publishing Co...Honolulu, T. H.
KDZA Arizona Daily Star.....Tucson, Ariz.
KDZB Frank E. Siefert .....Bakersfield, Calif.
KDZC The Beacon Co.....Seattle, Wash.
KDZF Automobile Club of So. Calif., Los Angeles, Calif.
KDZG Cyrus Peirce & Co.....San Francisco, Calif.
KDZH Fresno Evening Herald.....Fresno, Calif.
KDZI Electric Supply Co.....Wenatchee, Wash.
KDZK Nevada Machinery & Electric Co....Reno, Nev.
KDZL Rocky Mountain Radio Corp.....Ogden, Utah
KDZM R. A. Hellingworth .....Centralia, Wash.
KDZN William D. Fyle.....Denver, Colo.
KDZE Bellingham Publishing Co. ....Bellingham, Wash.
KDZT Seattle Radio Association.....Seattle, Wash.
KDZU Western Radio Corporation.....Denver, Colo.
KDZV Cope & Cornwell Co...Salt Lake City, Utah
KDZX Glad Tidings Tabernacle....San Francisco, Calif.
KDZZ Kinney Brothers & Sipprell.....Everett, Wash.
KFAD MacArthur Brothers Mercantile Co., Phoenix, Ariz.
KFAE State College of Washington.....Pullman, Wash.
KFAF Western Radio Corporation.....Denver, Colo.
KFAJ University of Colorado.....Boulder, Colo.
KFAM Electric Shop .....Moscow, Idaho
KFAP Standard Publishing Co.....Butte, Mont.
KFAR City of San Jose.....San Jose, Calif.
KFAS O. K. Olsen.....Hollywood, Calif.
KFAT Home Motor Supply Co.....Reno, Nev.
KFAU Dr. S. F. Donohue.....Eugene, Ore.
KFAV Independent School District....Boise City, Idaho
KFAW Abbott-Kinney Co. .....Venice, Calif.
KFAY The Radio Den, Ashford & White, Santa Anna, Cal.
KFAZ W. J. Virgin Milling Co....Central Point, Ore.
KFBB C. H. Weatherell .....Reddley, Calif.
KFBC F. A. Buttrey & Co.....Havre, Mont.
KFBD W. K. Ashill .....San Diego, Calif.
KFBE Clarence V. Welch.....Hanford, Calif.
KFBK Reuben H. Horn.....San Luis Obispo, Calif.
KFBL Kimball-Upson Co.....Sacramento, Calif.
KFBS Lease Brothers .....Everett, Wash.
KFBU Cascade News and Gas & Elec. Supply Co., Trinidad, Colo.

KFBU Bishop N. S. Thomas.....Laramie, Wyo.
KFBV Clarence O. Ford.....Colorado Springs, Colo.
KFCB Nielsen Radio Supply Co.....Phoenix, Ariz.
KFCC Auto Supply Co. .....Wallace, Idaho
KFCD Salem Elec. Co. .....Salem, Ore.
KFCF Frank A. Moore.....Walla Walla, Wash.
KFCH Electric Service Station.....Billings, Mont.
KFCK Colorado Springs Radio Co., Colorado Springs, Colo.
KFCL Los Angeles Union Stock Yds..Los Angeles, Calif.
KFCM Richmond Radio Shop .....Richmond, Calif.
KFCP Ralph W. Flygare.....Ogden, Utah
KFCQ Motor Service Station.....Casper, Wyo.
KFCV Fred Mahaffey, Jr.....Houston, Tex.
KFCY Western Union College.....Le Mars, Iowa
KFDA Adler's Music Store.....Baker, Ore.
★KFDB Mercantile Trust Co.....San Francisco, Calif.
KFDC Radio Supply Co. .....Spokane, Wash.
KFDD St. Michaels Cathedral.....Boise, Idaho
KFDF Wyoming Radio Corp. .....Casper, Wyo.
KFDH University of Arizona .....Tucson, Ariz.
KFDJ Oregon Agri. College .....Corvallis, Ore.
KFDL Knight-Campbell Music Co.....Denver, Colo.
KFDR Bullock's Hardware & Sporting Goods, York, Nebr.
KFEB The City of Taft.....Taft, Calif.
KFEC Meier & Frank Co.....Portland, Ore.
KFEJ Guy Gresson .....Tacoma, Wash.
KFEL Winner Radio Corporation.....Denver, Colo.
KFEP Radio Equipment Co. .....Denver, Colo.
KFFA Dr. R. C. Shelton .....San Diego, Calif.
KFFE Eastern Oregon Radio Co.....Pendleton, Ore.
KFFJ Jenkins Furniture Co.....Boise, Idaho
KFFQ Marinhoffel Motor Co....Colorado Springs, Colo.
KFGB Loewenthal Brothers.....Pueblo, Colo
KFGF Buchanan Stevens & Co.....Mt. Vernon, Wash.
KFGG Astoria Budget .....Astoria, Oregon
KFGH Leland Stanford, Jr., Univ..Stanford Univ., Calif.
KFHJ Fallon Co. .....Santa Barbara, Calif.
KFAM Midland Refining Co.....El Dorado, Kans.
KFBL T. & H. Radio Co.....Anthony, Kans.
KFBS D. W. May, Inc. .....Newark, N. J.
KFBT Southern Radio Corporation....Charlotte, N. C.
KFBU City of Chicago.....Chicago, Ill.
KFBZ Westinghouse Elec. & Mfg. Co..Springfield, Mass.
KFCE Findley Electric Co.....Minneapolis, Minn.
KFCK Stix-Baer-Fuller .....St. Louis, Mo.
KFCM University of Texas.....Austin, Tex.
KFCN Clark University .....Worcester, Mass.
Detroit Free Press.....Detroit, Mich.
KFDM Church of the Covenant.....Washington, D. C.
KFDT Ship Owners Radio Service....New York, N. Y.
KFDV John O. Yelser, Jr. .....Omaha, Nebr.
KFDZ James L. Bush.....Tuscola, Ill.
KFEB Renwood Co. .....St. Louis, Mo.
KFEH Midland Refining Co. .....Tulsa, Okla.
KFEV Huriburt-Still Electrical Co.....Houston, Tex.
KFEW St. Louis University.....St. Louis, Mo.
★KFFI Strawbridge & Clothier.....Philadelphia, Pa.
KFFY Cosradio Co. .....Wichita, Kans.
KFGF The Register & Tribune .....Des Moines, Iowa.
KFGI American Radio and Research Corporation, Medford Hillside, Mass.
KGL Thomas F. J. Howlett.....Philadelphia, Pa.
★KGM Atlanta Constitution .....Atlanta, Ga.
KGR Federal Tel. & Tel. Co.....Buffalo, N Y.
KGV Interstate Electric Co.....New Orleans, La.
★KGY General Electric Co.....Schenectady, N. Y.
KHA University of Wisconsin.....Madison, Wis.
★KHB Sweeney School Co.....Kansas City, Mo.
KHD West Virginia University.....Morgantown, W. Va.
KHK Warren R. Cox.....Cleveland, Ohio
KHN Ridgewood Times Printing & Pub. Co., Ridgewood, N. Y.
KHX Iowa Radio Corporation.....Des Moines, Iowa
KIK K. & L. Electric Co. .....McKeesport, Pa.
KKL Continental Electric Supply Co...Washington, D. C.
★KIP Gimbel Brothers .....Philadelphia, Pa.
KIZ Cino Radio Mfg. Co. .....Cincinnati, Ohio
KJD Richard H. Howe.....Granville, Ohio
KJH White & Boyer.....Washington, D. C.
KJK Service Radio Equipment Co.....Toledo, Ohio
KJX DeForest Radio Tel. & Tel. Co...New York, N. Y.
KJZ Radio Corporation of America—Westinghouse Elec. & Mfg. Co., Newark, N. J.
KKA Landaus Music & Jewelry Co..Wilkes-Barre, Pa.
KKC Joseph M. Zamolski Co.....Baltimore, Md.
KKN Bischman-Crosby Co. .....Memphis, Tenn.
KKY Oklahoma Radio Shop.....Oklahoma City, Okla.
KLB University of Minnesota.....Minneapolis, Minn.
KLK Hamilton Mfg. Co.....Indianapolis, Ind.
KLW Crosley Mfg. Co.....Cincinnati, Ohio
KMA Arrow Radio Laboratories.....Anderson, Ind.
KMB Auburn Electrical Co. .....Auburn, Me.
KNH Precision Equipment Co. .....Cincinnati, Ohio
KMU Doubleday-Hill Electrical Co....Pittsburgh, Pa.
KNJ Shotton Radio Mfg. Co. .....Albany, N. Y.
KNO Wireless Telephone Co. of Hudson County, N. J., Jersey City, N. J.
★KOC Palmer School of Chiropractic....Davenport, Iowa
KOH Hatfield Electric Co. .....Indianapolis, Ind.
KOI Iowa State College.....Ames, Iowa
KOK Arkansas Light & Power Co....Pine Bluff, Iowa
★KOO John Wanamaker .....Philadelphia, Pa.
★KOQ Western Radio Co. .....Kansas City, Mo.
★KOR L. Bamberger Co. .....Newark, N. J.
KOS Missouri State Mktg. Bureau..Jefferson City, Mo.
KOU Metropolitan Utilities District.....Omaha, Nebr.
KOZ Palladium Printing Co. .....Richmond, Ind.
KPA Fort Worth Record.....Fort Worth, Tex.
KPG Nushawg Poultry Farm.....New Lebanon, Ohio
KPI Electric supply Co. .....Clearfield, Pa.
KPM Thomas J. Williams.....Washington, D. C.
KPO United Equipment Co. .....Memphis, Tenn.
KQX Walter A. Kushl .....Chicago, Ill.
KRK Doron Brothers Electric Co....Hamilton, Ohio
KRL Union College .....Schenectady, N. Y.
KRM University of Illinois.....Urbana, Ill.
KRP Federal Institute of Radio Telegraphy, Camden, N. J.

WRR City of Dallas (Police and Fire Signal Department), Dallas, Tex.
WRW Tarrytown Radio Research Laboratory, Tarrytown, N. Y.
★WSB Atlanta Journal .....Atlanta, Ga.
WSL J. & M. Electric Co.....Utica, N. Y.
WSY Alabama Power Co.....Birmingham, Ala.
WSZ Marshall-Gerken Co. .....Toledo, Ohio
WTG Kansas State Agr. College....Manhattan, Kans.
WTP George M. McBride.....Bay City, Mich.
WWB Daily News Printing Co.....Canton, Ohio
WWJ Ford Motor Co.....Dearborn, Mich.
★WWJ The Detroit News.....Detroit, Mich.
WWL Loyola University.....New Orleans, La.
WWZ John Wanamaker .....New York, N. Y.
WAAB Valdmar Jensen .....New Orleans, La.
WAAC Tulane University .....New Orleans, La.
WAAD Ohio Mechanics Institute.....Cincinnati, Ohio
WAAF Chicago Daily Drovers' Journal.....Chicago, Ill.
WAAH Commonwealth Electric Co.....St. Paul, Minn.
WAAJ Eastern Radio Institute.....Boston, Mass.
WAAK Gimbel Brothers .....Milwaukee, Wisc.
WAAL Beamish Electric Co.....Minneapolis, Minn.
WAAM L. E. Nelsen Co.....Newark, N. J.
WAAN University of Missouri .....Columbia, Mo.
WAAP Otto W. Taylor.....Wichita, Kans.
WAAQ New England Motor Sales Co...Greenwich, Conn.
WAAS Georgia Radio Co. .....Decatur, Ga.
WAAW Omaha Grain Exchange.....Omaha, Nebr.
WAAY Yahriing-Raynor Piano Co.....Youngstown, Ohio.
WAAZ Hollister-Miller Motor Co.....Emporia, Kans.
WAAV Indiana Pipe Line Corp.....Princeton, Ind.
WBAA Purdue University .....West Lafayette, Ind.
WBAD Sterling Electric Co. and Journal Printing Co., Minneapolis, Minn.
WBAH The Dayton Co. .....Minneapolis, Minn.
WBAN Wireless Phone Corp.....Paterson, N. J.
WBAO James Millikin University.....Decatur, Ill.
★WBAP The Star Telegram.....Fort Worth, Tex.
WBAU Republican Publishing Co.....Hamilton, Ohio
WBAV Ermer & Hopkins Co.....Columbus, Ohio
WBAW Marietta College .....Marietta, Ohio
WBAX John H. Stenger, Jr. .....Wilkes-Barre, Pa.
★WBAY American Tel. & Tel. Co.....New York, N. Y.
WCAB Newburgh News Printing & Publishing Co., Newburgh, N. Y.
WCAD St. Lawrence University.....Canton, N. Y.
★WCAE Kaufman & Baer Co.....Pittsburgh, Pa.
WCAF Michigan Limestone & Chemical Co., Rodgers, Mich.
WCAG Daily States Publishing Co.....New Orleans, La.
WCAH Entrekin Electric Co .....Columbus, Ohio
WCAJ Nebraska Wesleyan University, University Pl., Neb.
WCAK Alfred P. Daniel.....Houston, Tex.
WCAL St. Olaf College.....Northfield, Minn.
WCAM Villanova College .....Villanova, Pa.
WCAO Sanders & Stayman Co.....Baltimore, Md.
WCAR Alamo Radio Electric Co....San Antonio, Tex.
WCAS William Hood Dunwoody Industrial Institute, Minneapolis, Minn.
WCAT South Dakota State School of Mines, Rapid City, S. Dak.
WCAU Philadelphia Radiophone Co...Philadelphia, Pa.
WCAV J. C. Dice Electric Co.....Little Rock, Ark.
WCAX University of Vermont.....Burlington, Vt.
WCAY Kesselman O'Driscoll Co.....Milwaukee, Wisc.
WCAC Illinois Watch Co. .....Springfield, Ill.
WDAE Tampa Daily Times.....Tampa, Fla.
★WDAF Kansas City Star.....Kansas City, Mo.
WDAH Mine & Smelter Supply Co.....El Paso, Tex.
WDAI Hughes Electrical Corp.....Syracuse, N. Y.
WDAJ Atlanta & West Point R. R. Co., College Park, Ga.
WDAK The Courant .....Hartford, Conn.
WDAL Florida Times Union.....Jacksonville, Fla.
WDAM Weston Electric Co. .....New York, N. Y.
WDAO Automotive Electric Co. .....Dallas, Tex.
WDAP Midwest Radio Central, Inc.....Chicago, Ill.
WDAR Lit Brothers .....Philadelphia, Pa.
WDAS Samuel W. Waite .....Worcester, Mass.
WDAU Slooum & Kilburn.....New Bedford, Mass.
WDAX First National Bank.....Centerville, Iowa
WDAY Kenneth M. Hance.....Fargo, N. D.
WEAA Fallain & Lathrop.....Flint, Mich.
WEAB Standard Radio Equipment Co., Fort Dodge, Ia.
WEAC Baines Electric Service Co...Terre Haute, Ind.
WEAD Northwest Kansas Radio Sup. Co., Atwood, Kans.
WEAE Virginia Polytechnic Institute..Blacksburg, Va.
★WEAF Western Electric Co. .....New York, N. Y.
WEAG Nichols-Hinelins-Bennett.....Edgewood, R. I.
WEAH Wichita Board of Trade & Landers Radio Co., Wichita, Kans.
WEAI Cornell University.....Ithaca, N. Y.
WEAJ University of South Dakota..Vermillion, S. D.
WEAK Julius B. Abercrombie.....St. Joseph, Mo.
WEAM Borough of North Plainfield, North Plainfield, N. J.
WEAN Shepard Company .....Providence, R. I.
WEAO Ohio State University.....Columbus, Ohio
WEAP Mobile Radio Co., Inc.....Mobile, Ala.
WEAR Baltimore Am. & News Pub. Co., Baltimore, Md.
WEAS Hecht Company .....Washington, D. C.
WEAT John J. Fogarty .....Tampa, Fla.
WEAU Davidson Brothers Co. .....Sioux City, Iowa
WEAV Sheridan Electric Service Co...Rushville, Nebr.
WEAW Arrow Radio Laboratories.....Anderson, Ind.
WEAX T. J. M. Daly.....Little Rock, Ark.
WEAY Will Herwitz, Jr. .....Houston, Tex.
WEAZ Donald Redmond .....Waterloo, Iowa
★WFAA A. H. Belo & Co. .....Dallas, Tex.
WFAB Carl F. Weese.....Syracuse, N. Y.
WFAC Superior Radio Co. .....Superior, Mich.
WFAD Watson, Weldon Motor Supply Co., Salina, Kans.
WFAF Henry C. Spratley.....Poughkeepsie, N. Y.
WFAG Radio Engineering Laboratory, Waterford, N. Y.
WFAH Electrical Supply Co.....Port Arthur, Tex.

WFAJ	Hi-Grade Wireless Instrument Co.,	Asheville, N. C.
WFAM	Times Publishing Co.	St. Cloud, Minn.
WFAN	Hutchinson Elec. Service Co.	Hutchinson, Minn.
WFAQ	Missouri Wesleyan College and Cameron Radio Company	Cameron, Mo.
WFAS	United Radio Corporation	Fort Wayne, Ind.
WFAT	Daily Argus Leader	Sioux Falls, S. D.
WFAU	Edwin C. Lewis, Inc.	Boston, Mass.
WFAV	University of Nebraska	Lincoln, Nebr.
WFAW	Miami Daily Metropolic	Miami, Fla.
WFAY	Daniels Radio Supply Co.	Independence, Kans.
WFAZ	South Carolina Radio Shop	Charleston, S. C.
WGAB	QRV Radio Co.	Houston, Tex.
WGAC	Orpheum Radio Stores Co.	Brooklyn, N. Y.
WGAD	Spanish Am. Schl. of Telegraphy,	Ensenada, P. R.
WGAH	New Haven Elec. Co.	New Haven, Conn.
WGAJ	W. H. Glass	Shenandoah, Iowa
WGAK	Macon Electric Co.	Macon, Ga.
WGAL	Lancaster Elec. Supply & Const. Co.,	Lancaster, Pa.
WGAM	Orangeburg Radio Equipment Co.,	Orangeburg, S. C.
WGAN	Cecil E. Lloyd	Pensacola, Fla.
WGAQ	W. G. Patterson	Shreveport, La.
WGAR	Southern American	Forth Smith, Ga.
WGAT	American Legion, Dept. of Nebr.,	Lincoln, Nebr.
WGAU	Marcus G. Lumb	Wooster, Ohio
WGAW	Ernest C. Albright	Altoona, Pa.
WGAX	Radio Electric Co., Washington Courthouse,	Ohio
WGAY	North Western Radio Co.	Madison, Wisc.
WGAZ	South Bend Tribune	South Bend, Ind.
WHAA	State University of Iowa	Iowa City, Ia.
WHAB	Clark W. Thompson	Galveston, Tex.
WHAC	Cole Brothers Elec. Co.	Waterloo, Iowa
WHAD	Marquette University	Milwaukee, Wisc.
WHAE	Automotive Electric Service Co.,	Sioux City, Ia.
WHAF	Radio Electric Co.	Pittsburgh, Pa.
WHAG	University of Cincinnati	Cincinnati, Ohio
WHAH	J. T. Griffin	Joplin, Mo.
WHAI	Radio Equipment & Mfg. Co.	Davenport, Iowa.
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.
WHAL	Lansing Capitol News	Lansing, Mich.
WHAM	School of Music, Rochester Univ.,	Rochester, N. Y.
WHAO	F. A. Hill	Savannah, Ga.
WHAP	Dewey L. Otta	Decatur, Ill.
WHAQ	Semmes Motor Co.	Washington, D. C.
WHAR	Paramount Radio & Elec. Co.,	Atlantic City, N. J.
WHAS	Courier Journal & Louisville Times,	Louisville, Ky.
WHAV	Wilmington Elec. & Supply Co.,	Wilmington, Del.
WHAW	Pierce Electric Co.	Tampa, Fla.
WHAX	Huntington Press	Huntington, Ind.
*WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.
WIAB	Jeslyn Automobile Co.	Rockford, Ill.
WIAD	Ocean City Yacht Club	Ocean City, N. J.
WIAE	Mrs. Rebt. E. Zimmerman	Venton, Ia
WIAF	Gustav A. DeCortin	New Orleans, La.
WIAH	Continental Radio Mfg. Co.	Newton, Ia.
WIAI	Heers Stores Co.	Springfield, Mo.
WIAJ	Fox River Valley Radio Supply Co.,	Neenah, Wisc.
WIAK	The Stockman Journal	Omaha, Nebr.
WIAP	J. A. Rudy & Sons	Paducah, Ky.
WIAQ	Chronicle Publishing Co.	Marion, Ind.
WIAS	Burlington Hawkeye-Heme Elec. Co.,	Burlington, Ia.
WIAT	Leon T. Noel	Tarkio, Mo.
WIAU	American Sec. & Sav. Bank	La Mars, Ia.
WIAV	New York Radio Laboratories,	Binghamton, N. Y.
WIAW	Saginaw Radio & Elec. Co.	Saginaw, Mich.
WIAX	Capital Radio Co.	Lincoln, Nebr.
WIAY	Woodward & Lothrop	Washington, D. C.
WIAZ	Electric Supply Sales Co.	Miami, Fla.
WIAD	Jackson's Radio Eng. Lab.	Waco, Tex.
WIAE	Texas Radio Syndicate	San Antonio, Tex.
WJAG	Huse Publishing Co.	Norfolk, Nebr.
WJAJ	Y. M. C. A.	Dayton, Ohio
WJAK	White Radio Laboratory	Stockdale, Ohio
WJAM	D. M. Perhay	Cedar Rapids, Ia.
WJAN	Peoria Star & Peoria Radio Sales Co.	Peoria, Ill.
WJAP	Kelly-Duluth Co.	Duluth, Minn.
WJAR	The Outlet Co.	Providence, R. I.
WJAS	Capper Publications	Topeka, Kans.
WJAT	Kelley-Vawter Jewelry Co.	Marshall, Mo.
WJAU	Yankton College	Yankton, S. D.
WJAX	The Union Trust Co.	Cleveland, Ohio
WJAZ	Chicago Radio Laboratory	Chicago, Ill.
WKAA	H. F. Paar & Republican Times,	Cedar Rapids, Ia.
WKAC	Star Publishing Co.	Lincoln, Nebr.
WKAF	W. S. Radio Supply Co. and Wm. Schack,	Wichita Falls, Tex.
WKAG	Edwin T. Bruce, M.D.	Louisville, Ky.
WKAH	Planet Radio Co.	West Palm Beach, Fla.
WKAK	Okfuskee County News	Okemah, Okla.
WKAL	Gray & Gray	Orange, Tex.
WKAN	Alabama Radio Mfg. Co.	Montgomery, Ala.
WKAP	Dutee Wilcox Flint	Cranston, R. I.
WKAQ	Radio Corporation of Porto Rico,	San Juan, P. R.
WKAR	Michigan Agri. College	East Lansing, Mich.
WKAS	L. E. Lines Music Co.	Springfield, Mo.
WKAV	Laconia Radio Club	Laconia, N. H.
WKAW	Turner Cycle Co.	Beloit, Wisc.
WKAX	Wm. A. MacFarlane	Bridgeport, Conn.
WKAY	Brenau College	Gainesville, Ga.
WLAC	North Carolina State College	Raleigh, N. C.
WLAF	Johnson Radio Co.	Lincoln, Nebr.
*WLAG	Cutting & Washington Radio Corp.,	Minneapolis, Minn.
WLAH	Samuel Woodworth	Syracuse, N. Y.
WLAJ	Waco Electrical Supply Co.	Waco, Tex.
WLAK	Bermont Farm Mach. Co.	Bellemeade, Ky.
WLAL	Tulsa Radio Co.	Tulsa, Okla.
WLAM	Morrow Radio Co.	Springfield, O.
WLAN	Putnam Hardware Co.	Houlton, Me.
WLAP	W. V. Jordon	Louisville, Ky.
WLAQ	A. E. Schilling	Kalamazoo, Mich.
WLAR	Mickel Music Co.	Marshalltown, Iowa
WLAS	Hutchinson Grain Radio Co.	Hutchinson, Kans.
WLAT	Radio and Specialty Co.	Burlington, Iowa
WLAV	Electric Shop, Inc.	Pensacola, Fla.
WLAW	New York Police Dept.	New York City, N. Y.
WLAX	Greencastle Community Broadcasting Station,	Greencastle, Ind.
WLAY	Northern Commercial Co. of Alaska,	Fairbanks, Alaska
WLAZ	Hutten & Jones Elec. Co.	Warren, Ohio
WMAB	Radio Supply Co.	Oklahoma City, Okla.
WMAC	F. Edward Page	Fernwood, Cazenovia, N. Y.
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.
WMAG	Tucker Electric Co.	Liberal, Kans.
WMAH	General Supply Co.	Lincoln, Nebr.
WMAI	Drovers Telegram Co.	Kansas City, Mo.
WMAK	Norton Laboratories	Lockport, N. Y.
WMAL	Trenton Hardware Co.	Trenton, N. J.
WMAM	Beaumont Radio Equipment Co.,	Beaumont, Tex.
WMAN	Broad Street Baptist Church	Columbus, Ohio.
WMAP	Utility Battery Service	Easton, Pa.
WMAQ	The Chicago Daily News	Chicago, Ill.
WMAR	Waterloo Electical Supply Co.	Waterloo, Iowa
WMAT	Paramount Radio Corporation	Duluth, Minn.
WMAV	Alabama Polytechnic Institute	Auburn, Ala.
WMAW	Wahpeton Elec. Co.	Wahpeton, N. D.
WMAX	K. & K. Radio Supply Co.	Ann Harbor, Mich.
WMAY	Kingshighway Presby. Church	St. Louis, Mo.
WMAZ	Mercer University	Macon, Ga.
WNAB	Park City Daily News	Bowling Green, Ky.
WNAC	Shepard Stores	Boston, Mass.
WNAD	Oklahoma Radio Eng. Co.	Norman, Okla.
WNAF	Enid Radio Distributing Co.	Enid, Okla.
WNAL	R. J. Rockwell	Omaha, Nebr.
WNAM	Ideal Apparatus Co.	Evansville, Ind.
WNAN	Syracuse Radio Tele. Co.	Syracuse, N. Y.
WNAP	Wittenberg College	Springfield, Ohio
WNAQ	Charleston Radio Elec. Co.	Charleston, S. C.
WNAR	C. C. Rhodes	Butler, Mo.
WNAS	Texas Radio Corporation and Austin Statesman,	Austin, Tex.
WNAT	Lenning Bros. Co.	Philadelphia, Pa.
WNAV	People's Tel. & Tel. Co.	Knoxville, Tenn.
WNAW	Henry Kunsmann	Fortress Monroe, Va.
WNAX	Dakota Radio Apparatus Co.	Yankton, S. D.
WNAY	Ship Owners' Radio Service	Baltimore, Md.
WOAA	Dr. Walter Hardy	Ardmore, Okla.
WOAB	Valley Radio	Grand Forks, N. D.
WOAC	Maus Radio Co.	Lima, Ohio
WOAD	Friday Battery & Elec. Co.	Sigourney, Iowa
WOAE	Midland College	Fremont, Nebr.
WOAF	Tyler Commercial College	Tyler, Tex.
WOAG	Apollo Theatre	Belvidere, Ill.
WOAH	Palmetto Radio Corp.	Charleston, S. C.
WOAI	Southern Equipment Co.	San Antonio, Tex.
WOAJ	Ervin's Electrical Co.	Parsons, Kans.
WOAK	Collins Hardware Co.	Frankfort, Ky.
WOAL	Wm. E. Woods	Webster Grove, Mo.
WOAN	James D. Vaughan	Lawrenceburg, Tenn.
WOAP	Kalamazoo College	Kalamazoo, Mich.
WOAQ	Portsmouth Radio Ass'n	Portsmouth, Va.
WOAR	Henry P. Lundskow	Kenosha, Wisc.
WOAS	Bailey's Radio Shop	Middletown, Ohio
WOAT	Boyd Martell Hamp	Wilmington, Del.
WOAU	Sowder Bolling Piano Co.	Evansville, Ind.
WOAV	Penna. National Guard	Erie, Pa.
WOAZ	Penick Hughes Co.	Stanford, Texas
WOAX	Franklyn J. Wolff	Trenton, N. J.
WOAY	John W. Wilder	Birmingham, Ala.
WPAB	Pennsylvania State College	State College, Pa.
WPAC	Donaldson Radio Co.	Omulgee, Okla.
WPAD	Wisboldt & Co.	Chicago, Ill.
WPAF	Peterson's Radio Co.	Council Bluffs, Iowa
WPAG	Central Radio Co., Inc.	Independence, Mo.
WPAH	Wisconsin Dept. of Markets	Waupaca, Wisc.
WPAJ	Doolittle Radio Corporation	New Haven, Conn.
WPAK	No. Dakota Agricultural College	Fargo, N. D.
WPAL	Superior Radio & Tel. Equipt. Co.,	Columbus, Ohio
WPAM	Awarbach & Guettel	Topeka, Kans.
WPAP	Theodore D. Phillips	Winchester, Ky.
WPAQ	General Sales & Eng. Co.	Frostburg, Md.
WPAR	R. A. Ward	Beloit, Kans.
WPAS	J & M Electric Co.	Amsterdam, N. Y.
WPAT	St. Patrick's Cathedral	El Paso, Tex.
WPAU	Concordia College	Moorhead, Minn.
WPAV	Paul Tinetti & Sons	Laurium, Mich.
WPAW	Radio Installation Co., Inc.	Wilmington, Del.
WPAX	S-W Radio Co., J. R. Shumate, Jr.	Thomasville, Ga.
WPAY	Bangor Radio Laboratory	Bangor, Me.
WPAZ	Dr. John R. Koch	Charleston, West Va.
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.
WQAB	Southwest Missouri State Teachers College,	Springfield, Mo.
WQAC	E. B. Gish	Amarillo, Tex.
WQAD	Whitall Electric Co.	Waterbury, Conn.
WQAE	Moore Radio News Station	Springfield, Vt.
WQAF	Sandusky Register	Sandusky, Ohio
WQAH	Brock-Anderson Elec. Eng. Co.,	Lexington, Ky.
WQAJ	Ann Arbor Times-News	Ann Arbor, Mich.
WQAK	Appel-Higley Electric Co.	Dubuque, Iowa
WQAL	Cole County Tel. and Tel. Co.	Mattoon, Ill.
WQAM	Electrical Equipment Co.	Miami, Fla.
WQAN	Scranton Times	Scranton, Pa.
WQAO	Calvary Baptist Church	New York, N. Y.
WQAQ	West Texas Radio Co.	Abilene, Tex.
WQAR	Press Publishing Co.	Muncie, Ind.
WQAS	Walter Prince Co.	Lowell, Mass.
WQAY	Gaston Music & Furniture Co.	Hastings, Nebr.
WRAA	Rice Institute	Houston, Texas
WRAC	State Normal School	Mayville, N. D.
WRAD	Taylor Radio Shop	Marion, Kans.
WRAJ	M. H. Pickering Co.	Pittsburgh, Pa.
WRAM	Lombard College	Galesburg, Ill.
WRAN	Black Bawk Elec. Co.	Waterloo, Iowa
WRAO	Radio Service Co.	St. Louis, Mo.
WRAR	Jacob C. Thomas	David City, Nebr.
WRAU	Amarillo Daily News	Amarillo, Tex.
WRAV	Antioch College	Yellow Spring, Ohio
WRAY	Radio Sales Corporation	Scranton, Pa.
WSAA	B. S. Sprague Elec. Co.	Marietta, Ohio
WSAB	Southeast Mo. State College,	Cape Girardeau, Mo.
WSAH	A. G. Leonard, Jr.	Chicago, Ill.
WSAJ	Grove City College	Grove City, Pa.
WSAL	Franklin Elec. Co.	Brookville, Ind.
WSAS	State of Nebraska	Lincoln, Nebr.
WSAT	Plainview Electric Co.	Plainview, Texas
WSAV	Clifford W. Vick, Radio Construction Co.,	Houston, Tex.
WTAC	Penn Traffic Co.	Johnstown, Pa.
WTAU	Ruegy Battery & Elec. Co.	Tecumseh, Nebr.
WTAW	Agricultural & Mechanical College of Texas,	College Station, Tex.
WWAC	Sanger Brothers	Waco, Tex.
WWAD	Wright & Wright, Inc.	Philadelphia, Pa.
WWAH	General Supply Co.	Lincoln, Nebr.
WWAX	Worman Brothers	Laredo, Tex.

Canadian Broadcasting Stations

CFAC	Radio Corporation of Calgary, Ltd.,	Calgary, Alberta
CFCA	Star Publishing and Printing Co.,	Toronto, Ontario
CFCB	Marconi Wireless Telegraph Co. of Canada, Ltd.,	Vancouver, B. C.
CFCD	Canadian Westinghouse Co., Ltd.,	Winnipeg, Manitoba
CFCE	Marconi Wireless Telegraph Co. of Canada,	Halifax, Nova Scotia
CFCF	Marconi Wireless Telegraph Co. of Canada, Ltd.,	Montreal, Quebec
CFCH	Abitibi Power and Paper Co., Ltd.,	Iroquois Falls, Ontario
CFCI	Motor Products Corporation,	Walkerville, Ontario
CFCN	W. W. Grant Radio, Ltd.	Calgary, Alberta
CFCX	The London Advertiser	London, Ontario
CFPC	International Radio Development Co.,	Fort Frances, Ontario
CFTC	The Bell Telephone Co. of Canada,	Toronto, Ontario
CFUC	University of Montreal	Montreal, Quebec
CFVC	Roy Russell Brown	Courtenay, British Columbia
CFYC	Victor Wentworth Odlum	Vancouver, B. C.
CFZC	Canadian Westinghouse Co., Ltd.	Montreal, Quebec
CHAC	Radio Engineers, Ltd.	Nova Scotia, Halifax
CHBC	The Albertan Publishing Co.,	Calgary, Alberta
CHCA	Radio Corporation of Vancouver, Ltd.,	Vancouver, B. C.
CHCB	Marconi Wirless Telegraph Co. of Canada, Ltd.,	Toronto, Ontario
CHCC	Canadan Westinghouse Co., Ltd.,	Edmonton, Alberta
CHCF	Radio Corporation of Winnipeg, Ltd.,	Winnipeg, Manitoba
CHCQ	The Western Radio Co., Ltd.,	Calgary, Alberta
CHCS	Landell Radio Shoppe	London, Ontario
CHCX	B. L. Silver	Montreal, Quebec
CHCZ	The Globe Printing Co.	Toronto, Ontario
CHFC	John Millien & Sons, Ltd.	Toronto, Ontario
CHIC	Canadian Westinghouse Co., Ltd.,	Hamilton, Ontario
CHOC	Canadian Westinghouse Co., Ltd.,	Vancouver, B. C.
CHVC	Metropolitan Motors, Ltd.	Toronto, Ontario
CHXC	J. B. Booth, Jr.	Ottawa, Ontario
CHYC	Northern Electric Co.	Montreal, Quebec
CJBC	Dupuis Freres	Montreal, Quebec
CJCA	The Edmonton Journal, Ltd.,	Edmonton, Alberta
CJCB	James Gordon Bennett,	Nelson, British Columbia
CJCD	T. Eaton Co., Ltd.	Toronto, Ontario
CJCE	Vancouver Sun Radiotelephone, Ltd.,	Vancouver, B. C.
CJCF	News Record, Ltd.	Kitchener, Ontario
CJCG	Manitoba Free Press Co., Ltd.,	Winnipeg, Manitoba
CJCH	The United Farmers of Ontario,	Toronto, Ontario
CJCI	McLean, Holt & Co., Ltd.,	St. John, New Brunswick
CJCN	Simons Agnew & Co.	Toronto, Ontario
CJCS	Eastern Telephone and Telegraph Co., Ltd.,	Halifax, Nova Scotia
CJCY	Edmund Taylor	Calgary, Alberta
CJGC	London Free Press Printing Co., Ltd.,	London, Ontario
CJNC	Tribune Newspaper Co., Ltd.,	Winnipeg, Manitoba
CJSC	The Evening Telegram	Toronto, Ontario
CKAC	La Presse Publishing Co.	Montreal, Quebec
CKCB	T. Eaton Co., Ltd.	Winnipeg, Manitoba
CKCD	Vancouver Daily Province	Vancouver, B. C.
CKCE	Canadian Independent Telephone Co., Ltd.,	Toronto, Ontario
CKCK	Leader Publishing Co., Ltd.,	Regina, Saskatchewan
CKCR	Jones Electric Radio Co.,	St. John, New Brunswick
CKCS	The Bell Telephone Co. of Canada,	Montreal, Quebec
CKCZ	Canadian Westinghouse Co., Ltd.,	Toronto, Ontario
CKKC	Radio Equipment and Supply Co.,	Toronto, Ontario
CKOC	The Wentworth Radio Supply Co.,	Hamilton, Ontario
CKOC	Radio Supply Co. of London	London, Ontario
CKZC	Kelton Radio Engineering Co.,	Winnipeg, Manitoba

WORLD WIDE WIRELESS

Argentine Transradio Near Operation

SOME day next June it will be possible to exchange radiograms direct with the Argentine. During that month the great station at Monte Grande, near Buenos Aires, will be put into operation, affording Argentinians, for the first time, direct radio communication with Europe and North America, in fact, with any part of the globe where a correspondingly powerful station exists. The new Monte Grande transmitter resembles in essential particulars the Rocky Point installation of the Radio Corporation of America, and like it, is powered with alternators, but of Telefunken make.

Remarkable as it will be to carry on this radio traffic on both sides of the equator, still more remarkable is the history of the undertaking, in which four great radio corporations have shared. Though the Argentine station is owned by an Argentine firm known as Transradio Internacional, with a capital of over $13,000,000, the actual promoters, financial interests, and for the time being, operators, consist of representatives of the Radio Corporation of America, the Marconi Wireless Telegraph Co., Ltd., of London; the Compagnie Générale de Télégraphie sans Fil of Paris; and the Telefunken Company of Berlin. It is to these four countries that the major portion of the traffic from the Argentine may be expected to flow, which was one of the facts leading to their joining hands in the Argentine enterprise. However, it should be recognized that the main element making possible this interesting combination or consortium of four international companies was the large body of essential Marconi and other patents, under which the four companies concerned hold licenses, without which patents, and without the manufacturing and engineering facilities back of them, success would be impossible.

Transradio Internacional, whose president is Ing. Eduardo Huergo, has secured a concession for commercial radio traffic for a period of 50 years. Tolls about two-thirds those of the cable companies will be charged.

Construction has been under way for a number of months, using material supplied in part by the associated companies, and in part supplied locally. The plant covers an area of 560 hectares of land (about 1,200 acres) with a main building in the center for the high power apparatus, from which ten steel towers, each 210 meters high (about 682 feet) extend in two long lines, with a distance of 500 meters (about 1,625 feet) between each of them. Electrical energy will be supplied by the Cia. Hispano-Argentina de Electricidad from its sub-station at Banfield. The actual current put into the antenna system will be 400 kilowatts.

Receiving will be carried out at a separate station at Villa Eliza, where the Beverage antenna will be erected. Both the transmitting and receiving stations will be operated by remote control from a central office in Buenos Aires.

Lord Hambledon of England participates in the first broadcasting in London. He delivered an appeal for aid for the hospitals

Scheveningen Station Improved

THE Government of the Netherlands is enlarging the present radio station at Scheveningen. The new apparatus will be ready for operation early this year. It is designed to communicate with all parts of Europe and will be equipped to do broadcasting.

Radio Followed 5,000-Mile Storm

PLANS of the U. S. Weather Bureau for extension of its radio storm warning system to the entire North Atlantic Ocean are progressing with increased vigor since the remarkable feat of last Fall, when a disastrous hurricane was followed for 5,000 miles by means of radio reports. The storm started somewhere between the west coast of Africa and the Windward Islands, a short distance above the equator, traveled west by north at first, then recurved to the northeast when midway between Porto Rico and Bermuda. It passed close to the latter island, doing considerable damage, after which it worked up into the trans-Atlantic steamship lanes, where a large number of vessels were involved. It broke up on the west coast of Europe about two weeks after it was first reported.

Until it reached Bermuda, the storm was reported constantly by radio broadcasts by the Weather Bureau, enabling numbers of ships to change their course and avoid the center of the disturbance, in which even the staunchest ship would find itself in danger.

White Bill Passes House

THE White bill providing the basis for ending the present confusion in radio matters was passed by the U. S. House of Representatives, and up to the moment this issue of THE WIRELESS AGE goes to press the legislation that is so vital to the entire radio industry had not been considered by the Senate. That body has been busy with ratification of the agreement with England relative to the terms for refunding the British Debt, and with the Ship Subsidy plan. Inasmuch as the proposition for a Ship Subsidy has some energetic friends, and many determined enemies, a prolonged struggle over it is expected, and it is entirely possible that the Senate will consider nothing else before the present session of Congress ends on March 4th.

If that should be the case, there would be no hope of securing passage of the legislation for at least another year, and the country would be forced to endure the present confusion in the air for twelve months more.

Radio in Czechoslovakia

THREE radio-telegraph stations are now in operation in Czechoslovakia, and six are under construction, according to U. S. Consul Winans at Prague. The station of Brno, Moravia, has opened for business, establishing communication with HBB, the Swiss radio station at Berne; a regular schedule is now maintained three times daily. Its call is OKB.

Czechoslovakia's principal radio-telegraph station is at Prague, the capital, where a ten kw. set has been in operation since June, 1920. Another smaller station is maintained at Vinohrady, which serves the airplanes flying between Prague, Warsaw and Vienna. Exchange quotations and press reports are also handled for the State by this service.

At Kbely, near Prague, a 1-kw. station is nearing completion for special service to the aviation field at Kbely and public service. At Carlsbad, or Karlovy Vary, another 1-kw. set is being installed, principally to handle traffic during the "cure" season, when visitors from all over Europe throng the city to partake of its healing waters.

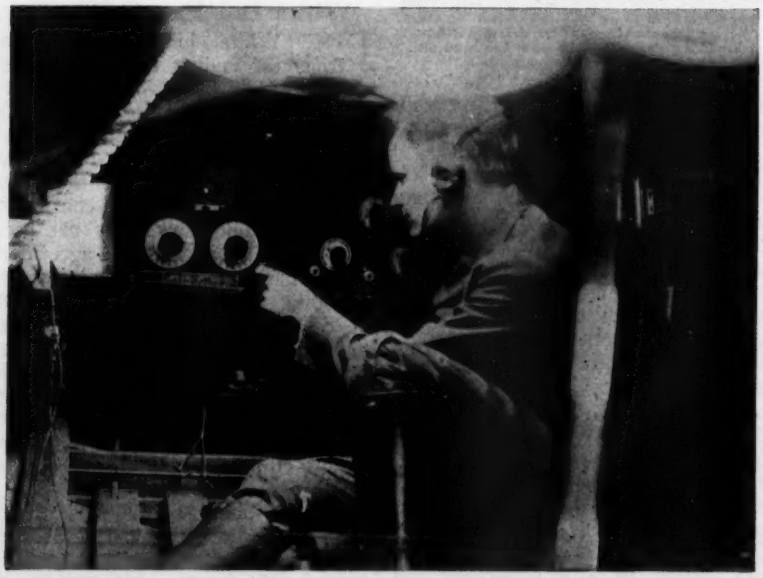
A 5-kw. station is in course of construction at Podebrady, Bohemia, which will eventually become the center of Czechoslovakian service. At this place there will also be erected a second station with two 50-kw. generators to be used for international communication. It will be ready for operation in a few months. Moravaska Ostrava is to have a station for serving the air route and general business in this industrial center. Kosice, Slovakia, has under way another 5-kw. station for general service, and a 5-kw. set is planned for Bratislava, Slovakia, for the International Danube Commission and Danube shipping.

Arctic Weather Reports

SCIENTIFIC support has been obtained for the proposal to broadcast wireless weather reports from the Arctic, British and Norwegian experts agreeing that the plan is feasible and would prove immensely valuable if carried into execution. Hagbard Ekerold, of Norway, an explorer and friend of Dr. Nansen, the famous explorer, is now in this country seeking aid for his scheme. The first station is already established, on Jan Mayen Island, and has done valuable work in reporting weather to Norway, for the protection of its fishing vessels. The most severe gales that beset navigation in the North Atlantic and North Pacific originate in the Arctic regions, it is claimed. Stations on Cape Dier, Baffin's Land; Bear Lake, Canada; and Point Barrow, Alaska, would cooperate with each other, with Jan Mayen.

Radio for Alaska Fishermen

THE Alaska Packers' Association will not have to guess about the position of its seven ships after the Radio Corporation of America has installed new radio equipment on them. Each ship will be fitted with a ½-kw. 500-cycle spark set, which will afford communication during the cruises to and from the fishing banks off Alaska. The sets are being installed on the following ships: *Star of Russia, Star of Italy, Star of France, Arapahoe, Edward Sewell, Star of Scotland,* and *Chilkat.*



Testing the radio set in the seaplane that started from New York for Brazil, piloted by Lieut. Walter Hinton. This plane never reached its destination, being partly wrecked near Cuba with no loss of life. Its successor, also radio equipped, succeeded in reaching Rio de Janeiro safely

Ongar Stations Are Efficient

THE English Marconi Company's engineers and operators have taken new pride lately in their medium-power vacuum tube transmitters located at North Weald, near Ongar, Essex, England. These were designed for working over comparatively short distances, but have been found to have much greater ranges, reaching far beyond Europe, for traffic with which they were designed. GLO, which works with Madrid, can be heard at Bandoeng, Java, 7,500 miles away, the chief of the Bandoeng radio department reporting hearing GLO nightly on two tubes. Another of the Ongar stations that is doing much more than was expected of it has performed so well that it now is used regularly in the trans-Atlantic traffic to Canada. It, like the others, had been erected for European traffic over not more than half the distance that it now covers.

Queensland Weather Reports

STORM warnings for the coast of Queensland are now broadcast by radio from December to April. The Commonwealth Meteorological Bureau advises the radio stations of the direction, severity and other details of cyclonic disturbances. In addition to the emergency messages, weather reports are transmitted at 4.30 p. m., local time, daily except Sunday, giving the state of the weather, direction and force of the wind, and state of the sea at 3 p. m., along the Queensland coast, with a forecast of probable conditions during the ensuing 24 hours. On Saturday the forecast is for the following 48 hours.

First Aircraft Licenses

SEVEN American commercial airplanes recently have been provided with radio transmitters and have been issued licenses. The first commercial flier to be so licensed in the United States was *Airline Arrow No. 1,* which flies out of Los Angeles, Cal. It was licensed last August, and had no rival until December, when the *Buckeye,* New York City, was licensed. Five others followed quickly, making seven in all. The list is as follows:

KFBI	*Airline Arrow No. 1,* Airline Transportation Co., Los Angeles, Calif.
KFBY	*Balboa,* Aeromarine Airways, Inc., New York City.
KFBA	*Buckeye,* Aeromarine Airways, Inc., New York City.
KFBF	*Gov. Cordeaux,* Aeromarine Airways, Inc., New York City.
KFBJ	*Nina,* Aeromarine Airways, Inc., New York City.
KFBM	*Ponce de Leon,* Aeromarine Airways, Inc., New York City.
KFBZ	*Santa Maria,* Aeromarine Airways, Inc., New York City.

These aircraft all have limited commercial licenses for transmission on 525 meters.

Development of Radio Standards

Institute of Radio Engineers and American Institute of Electrical Engineers to Co-operate in a Standardization Program

STANDARDIZATION of radio apparatus and service, the need for which grew up within practically the past year, has been undertaken by the Institute of Radio Engineers and the American Institute of Electrical Engineers. These two bodies, the leading engineering organizations in their respective fields, are co-operating in developing a standardization programme, and their mutual aid is pledged to the working out of the details of that programme as soon as its main lines have been determined.

This may well be considered the most important development in the field of wireless communications since broadcasting began. Though considerable time must elapse before the first standards are promulgated, and considerable time may be required to bring the work to such a point where large benefits will be derived, still the promise is definite and certain, and great advantages are assured all who come in contact with the radio industry, whether as manufacturers, distributors, dealers, or users of apparatus.

The standardization movement is to be attributed directly to the rapid rise of broadcasting, and specifically to the exceedingly unsatisfactory situation of a year ago when incompetent manufacturers and assemblers pushed out large quantities of practically worthless apparatus whose failure brought the industry into disrepute in the minds of large sections of the general public.

Direct impetus toward standardization was given by the United States Bureau of Standards, Washington, D. C., which early became cognizant of the situation, and late last Fall was requested by the I.R.E., the Radio Apparatus Section of the Associated Manufacturers of Electrical Supplies, the National Retail Dry Goods Association, the National Radio Chamber of Commerce, the American Radio Relay League, and the Radio Corporation of America, to take action to bring about the evolution of radio standards. The Bureau thereupon issued a call for a conference to consider the subject, on January 12 in New York City. It was at that conference, widely attended by representatives of radio firms and organizations, that it was decided to entrust the development of radio standards to the I.R.E. and the A.I.E.E. jointly.

These two organizations will carry out their work along the lines that have been pursued by engineering organizations in other fields in developing standards, under the form of procedure developed by the American Engineering Standards Committee. This will give the standards, when developed, a national standing and authority.

As the first step toward standardization a general committee of the I.R.E. and the A.I.E.E. is being formed, which will determine the scope of action, and appoint sub-committees, and probably sub-sub-committees to carry on the work. This general committee will have back of it an advisory committee, constituted as follows:—

For the Department of Commerce, Dr. J. H. Dellinger and Mr. L. E. Whittemore.
For the Navy, Commander S. C. Hooper.
For the Army, Major L. B. Bender.
For the National Radio Chamber of Commerce, Mr. G. H. Lewis.
For the Radio Section of the Associated Manufacturers of Electrical Supplies, Mr. M. C. Rypinski.
For the National Retail Dry Goods Association, Mr. Wm. A. Fitzgerald.
For the Pacific Radio Trade Association, Mr. Max Loewenthal.
For the Consulting Engineers, Mr. J. V. L. Hogan.
For the American Radio Relay League, Mr. K. B. Warner.
As a representative of the Standardization Committee of the Institute of Radio Engineers and former member of the American Institute of Electrical Engineers Standardization Committee, Mr. Donald McNicol.
For the Institute of Radio Engineers, Dr. A. N. Goldsmith.
For the American Institute of Electrical Engineers, Mr. L. T. Robinson.

The first action to be taken by the standardization committee that now is in process of formation probably will be the laying out of a general plan of action, settling the important question as to just how much shall be embraced in the standardization program. A primary question to be thus settled is whether or not to include the matter of service, in other words, whether to endeavor to set up requirements for service performed by transmitters, whether broadcasting, amateur or commercial. This question of course is a fundamental one, and a solution is not to be arrived at quickly, but only after careful deliberation by the committees and investigation of the governmental and industrial interests involved.

In fact, though service is highly important, benefits that are equally as great, and certainly easier of realization are seen in the proposal to standardize certain features of radio apparatus, both transmitting and receiving. At the present time there is utter confusion in the radio industry in the matter of rating parts and complete sets, and in dimensions. In the matter of rating, particularly, there are practices in use that are anything but exact.

For instance, the habit has grown up of rating variable condensers by the number of plates. This probably because the general public knows nothing of microfarads, and in the endeavor to make everything plain to the novice who was assembling his own set the newspaper radio editors talked only about plates. This stimulated manufacturers of little or no electrical ability to turn out condensers having the desired number of plates but whose electrical capacity when tested in the laboratory or in actual service was anything but satisfactory. The only suitable method of rating a condenser is by its capacity in microfarads, and the old-time manufacturers of course are adhering to this practice, while the newer ones may be expected to respond to the condenser standards when issued.

Again headphones now are customarily rated by their ohmic resistance to direct current. It is a matter of engineering knowledge that ohms give no measure of the efficiency of a headset. Ampere turns give a true picture of the phone, that is, the number of turns of wire multipled by the number of amperes flowing through them, for it is upon these two elements that the response of the diaphragm depends. The use of resistance for rating phones is not only inaccurate, but gives the unscrupulous manufacturer a chance for misrepresentation, as by using German silver resistance wire he can secure high resistance and an apparent high rating, such as would be justified only by the use of low resistance copper wire of many more turns.

In the matter of inductances such as variometers and variocouplers there is also room for improvement in methods of rating. Inductances are measured by henries, and it would be as proper for a man to go into a railroad station and ask for "a ticket" as to buy simply "a variometer," yet that is what thousands have been doing.

In the matter of dimensions of such parts as these and others there is the widest variation, so that in practically no case is it possible to substitute one manufacturer's part for that made by another. The one outstanding instance in which standardization already has been accomplished is that of plugs and jacks. The ease and convenience with which jacks and plugs may be interchanged gives a hint of the vast bene-

fits to be derived when similar standards are effective in other parts.

The radio standards after they are developed will make themselves felt in two ways, by their economy and convenience. Manufacturing processes are simpler and cheaper if concentrated on a small line instead of spread over many items each differing only slightly from the other. Use is cheaper and simpler if interchangeability is present. And standards in any industry have a great value in taking the attention of the manufacturers off unimportant details, allowing them to concentrate on fundamental design, and perfection of manufacture. This gives greater scope to the genius of the expert while making things easier for those who are content to follow rather than lead.

Every industry has standards of some kind or another. A striking example of their value is afforded by the automobile manufacturers, who have had an important number of standards developed for them by the Society of Automotive Engineers. Last year the leading executives of the automobile factories declared that these standards had resulted in an average saving of 15 per cent. in the retail cost of every car now running. In some parts, such as ball bearings, which were completely standardized, the saving exceeds 50 per cent. This of course is in manufacture alone, and even greater economies must be realized in repair work on automobiles everywhere. A similar prospect is ahead of the radio industry.

2EL Talks to 6XAD on 100 Watts

Trans-Continental Communication, by Voice Absolutely Without Parallel in Annals of Amateur Radio Operation—Summer at One Place and a Raging Blizzard at the Other

DURING the recent amateur trans-Atlantic tests H. H. Carman, Freeport, L. I., owner and operator of amateur station 2EL, successfully transmitted speech to England at two different times. Not being satisfied with that rare accomplishment, however, he went out after more records and now has the distinction of having successfully transmitted speech across the continent to 6XAD, Major Lawrence Mott's station at Avalon, Catalina Island, Calif., an achievement absolutely without parallel in the history of amateur radio operation.

This record-breaking ocean to ocean radio conversation, from an island in the Atlantic to one twenty miles off the Coast of California, took place at 4 a. m. Eastern Standard Time, on the morning of February 7. The power used was 100 watts, and the wave length 200 meters.

For several weeks these two stations have been in frequent communication and on the morning of January 31, between 4 and 5 a. m. Eastern Standard Time, were in communication by C.W., using the telegraphic code, for about an hour, during which time several messages were exchanged. Major

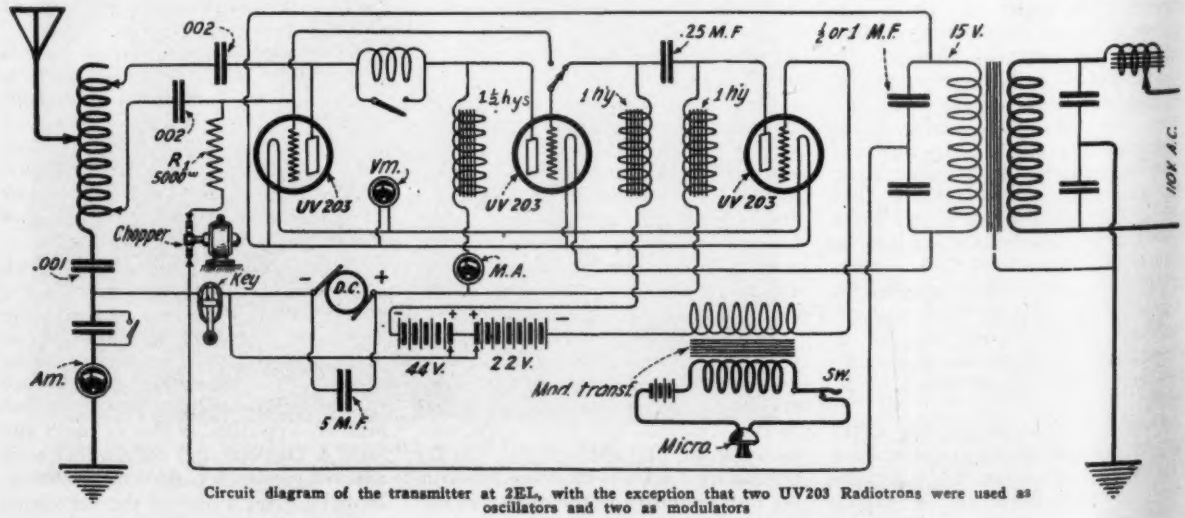
Antenna system at 2EL

Mott reported at that time that the telegraphic signals of 2EL station were so "thundering" strong on a detector only that when a standard loud speaker was connected the signals of 2EL, 2500 miles distant, could be read with ease while walking away from the receiver, *"across two rooms, then across the street and then a block away. At the next street beyond, the signals were still readable."*

This report of Major Mott aroused a desire on the part of Mr. Carman to try voice communication the next time the two stations were in communication. The opportunity came on the following Wednesday morning at 4 a. m., when 2EL called 6XAD, using straight, unmodulated C.W., and 6XAD replied immediately, reporting the signals of 2EL as strong and steady.

Upon hearing that Mr. Carman immediately switched over to voice communication and talked for some time to Major Mott. The latter replied by code, reporting clear reception of all speech from 2EL and offering congratulations on the unprecedented accomplishment. Major Mott reported reception of some more speech from 2EL and had started to transmit a message when his transmitter evidently overcome by excitement and enthusiasm over this new achievement of amateur radio, blew up. And there it ended.

Enough had been accomplished, however,



Circuit diagram of the transmitter at 2EL, with the exception that two UV203 Radiotrons were used as oscillators and two as modulators

to set up new standards in amateur radio operation. Island spoke to island, the Atlantic and the Pacific joined hands across the land. Radio had once more annihilated space. West was east and east was west. In no other single amateur accomplishment, in fact, not excepting the transmission of amateur signals to Europe, has the romance, the fascination of radio operation been more clearly, more wonderfully demonstrated than in this conversation between two amateurs, one on an island in the Atlantic and the other on an island thirty miles out in the Pacific.

During the conversation between Major Mott and Mr. Carman, the talk drifted to the weather.

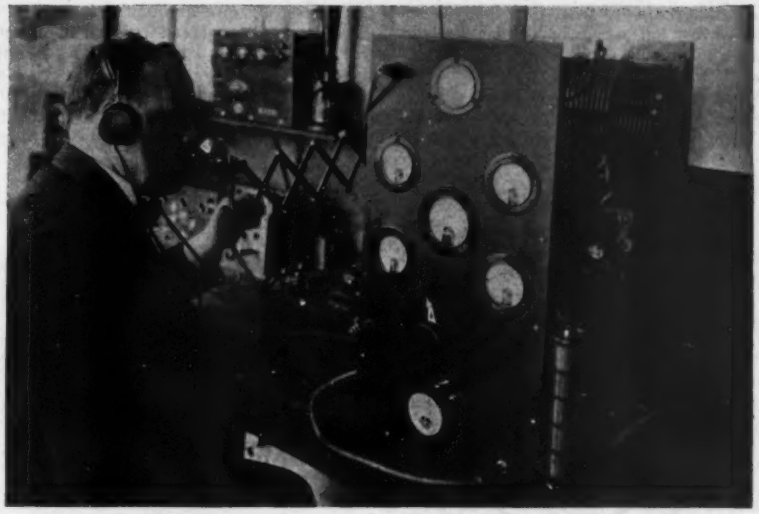
"How's the weather on Long Island this morning, old man?" asked Major Mott.

"Cold, DX cold," said Carman. "I'm sitting on an oil stove, bundled in two sweaters and an overcoat and am wearing heavy gloves—and slowly freezing to death."

"Serves you right, dot rot your hide," replied Major Mott, "why don't you live in a country like this, where it's Summer all the year 'round? Why, man alive, the flowers here are in full bloom, the night birds—no not hawks, birds—are calling sweetly to each other, and I have two fans going nearby to help keep me cool. Outside the stars are shining and a light breeze is waving the palm trees back and forth and—oh, well, isn't nature wonderful anyway?"

Now, that's a fine line to hand a man sitting in an outdoor shack in a temperature of 15 degrees above zero, with a blizzard raging outside. And from the way Carman tells it, Major Mott escaped assassination only because he was 2,500 miles away.

The set used at 2EL station in this unparalled voice transmission is the same one used during the recent trans-Atlantic tests, during which reception of speech was reported from England on two different nights. The C. W. signals of the station were also reported from England, France and Switzerland consistently during the tests. The set used and also the antenna and counterpoise ground system of the station were fully described in the November, 1922, issue of THE WIRELESS AGE. The equipment of 6XAD station has also been fully described in previous issues of THE WIRELESS AGE.



The genial H. H. Carman, owner and operator of Station 2EL and his famous set

In addition to 6XAD, Mr. Carman has carried on voice communication with operators at the following stations, some of whom replied by voice:

1AJP—Bridgeport, Conn.
4EA—New Bern, N. C.
5XAJ—Dublin, Texas.
5ES—Waco, Texas.
8AJX—Delaware, Ohio
8ALT—Dawson, Pa.
9CTR—St. Louis, Mo.

These, of course, are only a few stations selected from the great number with which 2EL has worked. The total number reporting speech from 2EL station runs up into the hundreds and includes stations all over the country.

"How Far Can I Receive?"

By Ray Dio

"HOW far can I receive?" That is probably the most common question asked of radio people today. The first million times it is asked there is a polite answer, something like this: "Individual conditions govern reception to such an extent that it is impossible to predict how far any receiver will receive. The only way to tell is to try and see." The second million times that the question pops up, it is ignored. The third million, the answer is: "! ! X * ? ? / : % ! !" And the fourth million ——.

Now all this is quite unnecessary. In the first place, why ask how far reception is possible when you can find out any time by turning the dials? In the second place, the conditions governing reception are definitely and positively indefinite. It is only in the case of the most carefully designed, high-power commercial stations, costing great sums, that the radio engineer can safely promise the ability to do thus and so, day after day and night after night.

Definite indefiniteness sounds rather highbrow and abstract, but it is anything but that. The indefiniteness of reception is a practical reality, recognized by all who operate receivers.

So, for the satisfaction of the disillusioned and the protection of the hopeful, let us have a clear explanation of the factors governing broadcast reception.

The first factor is the power of the broadcasting transmitter. The second is the sensitiveness of the broadcasting receiver. The third is the skill of the operator. The fourth is the weather. The fifth is the presence of interfering transmitters. The rest is legion.

Many wonder why they can hear stations three or four hundred miles or more distant, and can't get a peep out of much nearer ones. It is easy to say that the nearer fellows were too weak—didn't put enough power in the air. Then the puzzled one retorts that "John Brown across the street gets em." Therefore waves from the smaller transmitter are reaching the locality. It looks as if the sensitivity of the receiver may be at fault.

There is a very important point: the inherent quality of the receiving instrument. In general, it may be said that the better the reputation of the manufacturer, the larger his facilities, the more renowned his engineers, the better will be the performance of his receivers, because they will receive over a larger radius with greater volume. The difference between a good receiver, designed and made by experts, and one not so made, is astounding, as anyone will find who cares to compare two such instruments on the same antenna. The good one will pick up and make plain radio impulses that the poor one will not respond to. There is one of the biggest elements in reception over distance. To a certain extent, reception is built in the set.

In figure 1 two receivers of different make are shown. Let us presume, for example, that the waves from a broadcasting station, "T," barely reach the receiving antennas, located at the maximum range of the transmitter at the moment. No response is had at receiving station No. 1, even though the same number of tubes are in operation—detector and two stages of audio frequency—as at station No. 2, where the transmission from "T" is being received. In receiver No. 2, the circuit has been constructed along engineering lines and every precaution has been exercised to build an efficient receiving unit.

Striking examples of this are reported by inexperienced people who have constructed their own sets. They want to know why it is that they cannot receive as far as their neighbor, who is, perhaps, using a receiver of standard make. The facilities of one manufacturer against the other are incomparable—why compare the results of their product?

WEATHER CONDITIONS

Considering that the transmitter is powerful, and that an efficient receiver is being employed for the reception of the broadcast concerts, we still have another factor governing reception. That is the weather. Sci-

entists disagree as to what it is that carries radio waves, but whatever it may be, the weather is capable of upsetting it considerably.

Due perhaps to changes in cloud stratas, or variation of atmospheric pressure between two given points, signals from a transmitter put a program in everybody's ear, and do it nicely, too. No one can say that at present this concentration of broadcasting within the United States is beneficial. Each of us has two ears, but they have to be used together to listen to one thing at a time. It's useless or worse to have a dozen things ing from stations hundreds or thousands of miles away. Anyone residing close enough to a powerful broadcasting station should arrange his receiving equipment to get the maximum results from that station alone and disregard all others. That's the way to enjoy life on the radio wave!

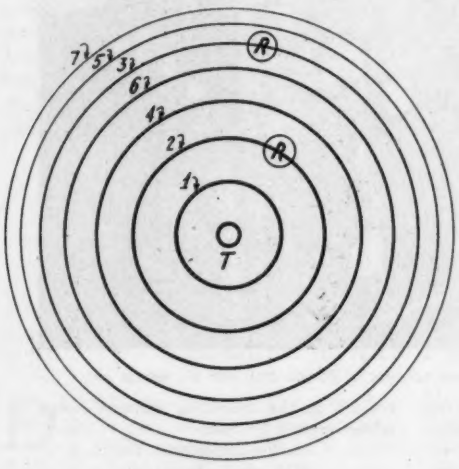


Figure 2

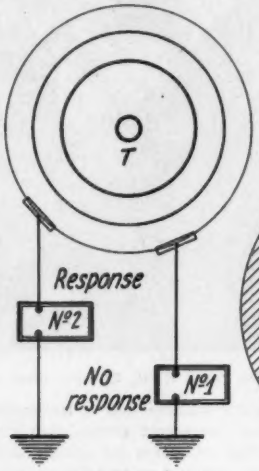


Figure 1

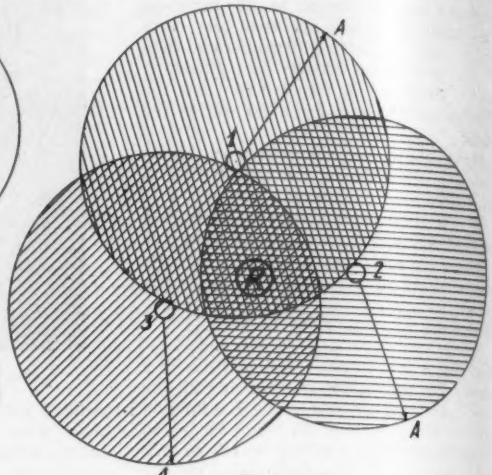


Figure 3

Diagrammatic representation of varying conditions affecting reception

may come in loudly, then fade out to practical inaudibility many times in fifteen minutes.

This can be explained by the drawing in figure 2.

Transmitter "T" has a daylight range of several hundred miles, its transmitting range being practically constant during the daytime, covering the area represented by circle No. 1. Just after sunset the radius of the transmitter is increased to that shown by the circle No. 2. By 8 p. m. the transmitter is reaching out still further and receiving station "R" picks up its concert. At 8:05 p. m. for some reason or other the effective range of the station has contracted a little, as far back as circle No. 4. Station "R-1" is then still receiving the concert, but probably has recorded change in strength.

At 8:10 p. m. the wave is expanding again and reaches out as far as circle No. 5. Station "R" is again receiving the concert, but this time louder than at 8 p. m. At 8:16 p. m. the range contracts again and goes back as far as circle No. 6. Station "R" has once more lost the transmitter entirely. However, at 8:22 p. m. conditions become very favorable and the station's wave reaches out as far as circle No. 7, and it remains this way until transmission has been finished.

This illustration is based upon an actual observation of the wave from a broadcasting station at Atlanta, Ga., located nearly due east of the author. It is not claimed that it has universal application, and is given here because it serves to explain matters to the many listeners who generally think that fading is due to failure of their own apparatus to function properly at times.

Interference

There are enough broadcasting stations now operating in the United States to provide entertainment for a country 253 times bigger. In fact, if the American broadcasters were apportioned out all over the world, probably there would be nough to clamoring into our ears at the same moment.

The situation can be presented by figure 3, in which "R" is any receiving station, yours, for instance. A transmitter broadcasting at 1, has a radius 1-A. Another station transmitting at 2, has a radius 2-A. Another station transmitting at 3, has a radius represented by the circle 3-A, and probably several local stations are broadcasting at the same time. For the sake of clarity, I will not add insult to injury by drawing the radii of these stations, some of which are but 5-watt noise makers who crave personal publicity.

Stations 1-2-3 and probably many others are crowded on, let us say, 360 meters. The listener happens to be so situated that the distance to either of them is practically the same. They are using the same power. The result is that you either receive one in a confusion of sounds like a Chinese music revue, or you get disgusted and shut off the vacuum tubes for the night.

Fortunately, old man, time comes to the rescue. The stations shut down at different times—the East shutting down before the West. However, at the present time any receiver worth the name will bring in at least ten stations at once, mixed so completely that none of them can be enjoyed. This is not the fault of the receiver.

You would not try to get 200 miles per hour out of a Ford—would you? Then don't try to do the impossible with your receiver.

At the present time the best you can do is to survey the "air" every evening and pick out the station that can be heard best. Be satisfied with that, and don't try to tune in those which are jumbled up together. There is no receiver in existence which will separate the transmitters, who of their own free will, are doing the mixing.

Local Broadcasters

Those who are fortunate enough to live in the immediate vicinity of a powerful broadcasting station should not weep over inability to listen to out-of-town stuff com-

Eliminating Interference from Commercial Power Lines

By J. L. Bernard

DURING the course of a series of measurements at the University of Maine on high power trans-Atlantic signals, serious interference from a single and three-phase transmission line was encountered. The disturbance seemed to be a function of the power transmitted over these wires which supplied about 50 KW. at 2,300, 220 and 110 volts for operating alternating current machinery as well as several hundred lamps scattered throughout the campus buildings.

After careful observation, it was found that practically all of the interference was caused by a single phase line running within twenty-five feet of the antenna lead-in although, when this circuit was entirely disconnected from the main switchboard, the 2,300-volt wires contributed an annoying hum. The latter passed the main antenna wires in two places; at the far end and also within 60 feet of the lead-in.

As the load over the system increased the induction became stronger and at times overwhelming. Even when the load was light, the interference drowned out the weaker European signals. My first thought was to shield the entire apparatus, which was loosely arranged over a laboratory table and consisted of a long wave receiver, condensers, three tubes, etc., connected with a storage battery beneath the table. To shift the position of the antenna would be a difficult task, for it was some five hundred feet long and was surrounded by buildings, trees, etc.

Shielding was carefully carried out as follows:

A steel case was fitted around the storage battery, leads were inserted in conduit, the inductance coils were sealed within a copper case and the amplifier parts well enclosed.

(*Continued on page* 86)

The Washington Monument as Radio Antenna

By S. R. Winters

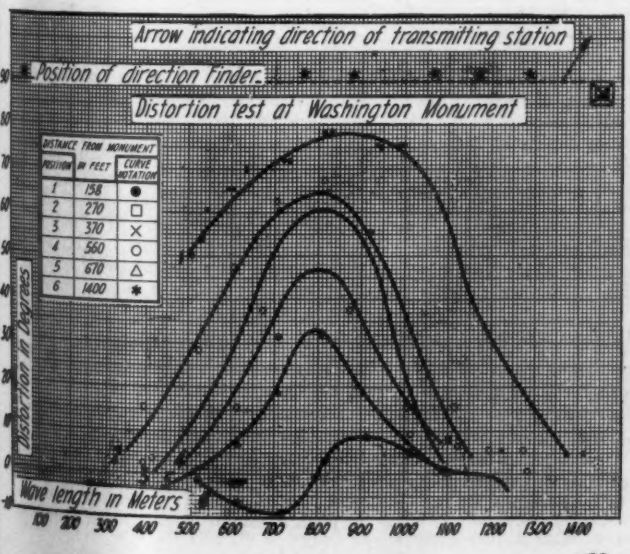
DIMINUTIVE aerials and antennas for the reception of radio-telephone communications—the wireless garter, match-box, ring and other freak receiving sets—stimulate the popular imagination. It is their dwarfish size and freakish identity with the dignified science of radio-telephony that stir the popular fancy. By a similar token, shifting from the extreme of diminutiveness to that of immensity can you imagine the Washington Monument as a potential antenna for the transmission and reception of radio-telephone and radio-telegraph communications? Strangely enough, as far-fetched as the application may appear, this structure, towering to a height of 555 feet, when its elevator and stairway are recognized, constitutes a reasonably efficient base for the manipulation of electromagnetic waves.

Not unlike conventional antennas, the Washington Monument in its imaginary perverted use would have a natural wavelength. Experiments, for other purposes than this article indicates, by radio authorities of no less caliber than F. A. Kolster and F. W. Dunmore, while conducting tests for the Bureau of Standards, United States Department of Commerce, to determine the fitness of the radio direction-finder as a nautical instrument, discovered that the normal wavelength of this 555-foot enduring memorial to the Father of Our Country is approximately 800 meters. At this range, computed by the yard-stick applied to the wonders of wireless waves, there was the greatest distortion of waves when the radio direction-finder was functioning in proximity to the Washington Monument. The theory that electromagnetic waves emanating from a transmitting station are likely to be somewhat swerved from their true course by the presence of big metallic structures or other energy-absorbing objects was borne out in this instance.

The Washington Monument

A portable direction-finder, designed and built at the Bureau of Standards, was employed in this interesting series of observations to determine the accuracy of the coil system in its contemplated use as a nautical instrument. These experiments involved a study of the influences of huge metallic structures and other energy-assembling objects on the preciseness of the direction-finder in locating the source from which electromagnetic waves are emanating. This portable unit, especially adapted to investigations undertaken afield, consists of a coil wound in two sections of five turns each, sewed in waterproof canvas. The coil is equipped with an electric switch by use of which the five-turn sections may be connected either in parallel or series. The use of a tuning condenser, having a maximum capacity of one-thousandth of a microfarad, enables the employment of a wavelength range of from 300 to 1,500 meters.

Observations when using the radio direction-finder near the Washington Monument are responsible for a conclusion of the two Government radio engineers that this 555-foot tall structure, including the elevator and stairway, is "a fairly efficient antenna." Maximum distortion of the electromagnetic waves occurred at a wavelength of approximately 800 meters. This observation leads to a further conclusion that this figure apparently represents the natural wavelength of the Washington Monument. Or, differently expressed, this towering structure, when considered as an antenna, is in tune at 800 meters. The fluctuating degrees of wave distortion, when the radio direction-finder was located at varying distances from the Washington Monument, are reflected in a curvature chart accompanying this article. The experiments to determine the directional qualities of the radio direction-finder, even though conducted under exaggerated circumstances, indicate the caution that should be exercised when locating transmitting radio stations anywhere on land.



Graphic chart of the distortion tests at Washington Monument and the loop antenna used

Selectivity of Single Circuit Regenerative Tuners

By Julius Weinberger

THIS article is written for persons who are novices in radio reception, possessing single circuit regenerative tuners, such as the Aeriola Senior, the R. C. tuner with R. A. amplifier or the A. A. 1300 tuner with A. A. 1400 amplifier (also known as Radiola V), made by the Radio Corporation of America, or similar sets, and who are experiencing difficulty in obtaining freedom from interference in their receivers. That property of a receiver which enables one to tune in a desired station, to the exclusion of undesired signals, is called its "selectivity."

The single circuit regenerative tuner is the simplest form of highly selective receiver, when properly installed and handled. It will do anything that more complicated sets, with twice as many knobs will do; and it is infinitely easier for the novice to adjust, in picking up distant stations. When the user is located in the country, at distances greater than fifty or one hundred miles from broadcasting stations, the single circuit tuner connected to an outdoor antenna, 75 or 100 feet long, will give entirely satisfactory service; and has been so used by skilled engineers in preference to more complicated sets because of its simplicity and the ease with which distant stations can be picked up.

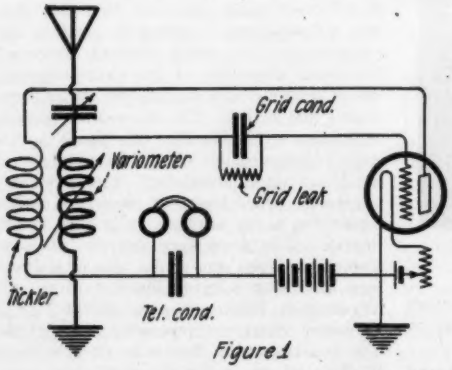


Figure 1

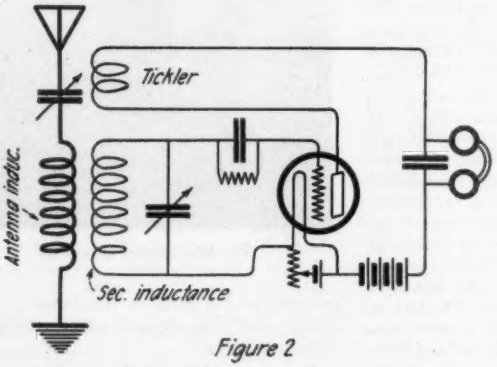


Figure 2

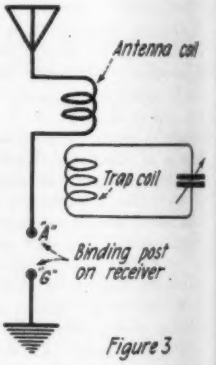


Figure 3

Single and two-circuit regenerative hook-ups and trap coil circuit

Interference in Radio Receiving Sets

It may be well at the outset to describe the different kinds of interference which one can hear in a radio broadcast receiver, and the extent to which it is possible to tune out the various kinds.

We have the following possible sources of interference:

(1) From other broadcasting stations than the one which it is desired to receive.

(2) From other receiving sets in the neighborhood.

(3) From amateur or commercial spark transmitting stations.

(4) From amateur C. W. (continuous wave) transmitting stations.

(1) Broadcasting Stations

Interference from this source is audible in two ways:

When the interfering station is considerably different in wavelength, it will be heard through the desired station in the form of its speech or music. That is, the speech being sent out by the interfering station will be mixed up with that being sent out by the desired station.

If the interfering station is quite close to the desired station in wave length, a whistle will be heard in addition to its speech. This whistle will be steady in tone, or will vary slowly. It is due to the interaction of the waves being radiated by the two stations; such an interaction always occurs between waves radiated by different transmitters, but when the wave lengths are considerably different the tone due to their interaction is inaudible; while the closer in wave length they are the lower in pitch will be the tone or whistle resulting from their interaction. Very often only the whistle itself will be heard, when the interfering station is far distant, its speech being too weak to be audible.

On any good regenerative receiver, single circuit or otherwise, there should be no difficulty in tuning out interfering stations whose wave length is sufficiently different from that of the desired station that no audible whistle results from their interaction. If the whistle is extremely high in pitch, almost inaudible, it should also be possible to tune out the interfering station; but if it is fairly low pitched, within the range that an ordinary person can whistle, there is no use in trying to get rid of it, since it would only result in a sacrifice of quality in the signals desired, and would require an expert in adjustment. The only thing to do in this case is to search for another station which is not interfered with by the whistles of other broadcasting transmitters, and pray for a reduction in the number of stations, as well as better regulation of the wavelengths of broadcasters.

It is important in this connection to emphasize the fact that more complicated receivers will not be of any assistance in tuning out these whistles, or "beat-notes" as they are called; and that if they are heard on a single-circuit tuner they are going to be heard on any other kind of tuner. The remedy lies in regulation of the transmitting stations and not in improvement of the receivers.

(2) Receiving Sets

When the tickler coupling in any present-day type of regenerative receiver is brought up to a certain point, a marked change occurs in the character of the signals being received, as they are heard in the telephones. They become mushy and confused, static and other underlying noises change from sharp, distinct sounds to more or less mushy ones, and, if the tuning handle is rotated a rising and falling whistle may be heard when one is receiving radiophone signals. The set is then in a condition known as "oscillating;" it has turned itself into a tiny radio transmitter and is sending out waves from your receiving antenna just the same as those radiated by the large broadcasting transmitters. This is a very undesirable condition, for when a set is oscillating, the waves it sends out are interfering with every other receiver in the neighborhood. The remedy for this condition, should it arise in your receiver, is to turn the "tickler" handle back to zero, and start over again, stopping before the "oscillating" point is reached. Interference due to other oscillating receivers is usually characterized by a whistle which changes rapidly in pitch, sometimes starting and stopping suddenly, as the other fellow makes his adjustments; and it has therefore been given the name of "birdie." In aggravated cases, the following plan has been known to bring relief: An ordinary telephone transmitter (such as used in your house telephone) is connected in series with your antenna wire; you then throw your own receiver into oscillation, thus making it a small transmitting station, talk into the telephone transmitter, and enunciate your sentiments concerning the person who is causing the interference. (The method is due to Mr. E. E. Bucher.) This should only be done when the "birdie" is very loud, indicating that some one in your immediate vicinity is causing the interference, since the power of your receiving set used as a radiophone transmitter is not great enough to enable it to be heard more than possibly half a mile.

It is needless to say that no improvement in a receiver can be made which will enable it to tune out "birdies." The case here is the same as with interference from broadcast transmitters; if the whistle is audible in pitch it cannot be eliminated. Sometimes

the following kind of interference is heard: You will be receiving a signal clearly when suddenly it will change in intensity and super-imposed on it there will appear a high-pitched whistle, at the same time greatly distorting the signals being received. This is usually due to some experimenter in the neighborhood, who has connected a "Super-Regenerative" outfit to an antenna. While it is possible to construct these sets so as not to produce such interference, the average experimenter does not know how to do so, and hence unwittingly gives rise to the noises referred to. The telephone transmitter circuit mentioned above might well be used to inquire the name and address of the person having the "Super-Regenerative" set in your neighborhood, so that an interview might be arranged.

(3) Amateur and Commercial Spark Transmitters

These are heard as more or less regular buzzing sounds, in telegraph code, and are characterized by the fact that they can be tuned in more loudly by decreasing the setting of your tuning handle. Amateur stations generally transmit on wave lengths between 200 and 300 meters, while the broadcast transmitters are above 300 meters. Therefore, if you hear buzzing sounds while you are tuned to a broadcast transmitter, see whether you can make them come in more loudly by increasing or decreasing the setting of your tuning handle. If they become louder by decreasing the setting, the interference is most probably due to amateurs (occasionally there are commercial stations on a wave length of 300 meters, but not usually); on the other hand, if the interfering buzz gets louder as you increase the setting, it is due to commercial stations.

It is practically impossible to build a receiver that will tune out a nearby spark station of the average type. The best plan in this case is to have some one who knows code come in and determine the call letters of the interfering station, and, if it is an amateur, endeavor to persuade him not to transmit during the evening broadcasting hours. However, if the interference is not overwhelmingly loud, the use of a single circuit receiver in the manner described later on, will help considerably in reducing interference from such sources.

(4) Amateur C. W. Transmitters

The characteristics of these are: Thumping sounds, in telegraph code, sounding very much like the instruments in a telegraph office, except that instead of clicks the signals are more of the character of dull thumps; or, telegraph signals in the form of a very low-pitched hum. The former are due to so-called "pure C. W." (in which the owners use high tension direct current for feeding their transmitters) while the latter are caused by C. W. transmitters in which "self-rectification" or high tension alternating current supply is employed, without means for "smoothing" it out.

The interference caused by amateur C. W. transmitters is not nearly as serious as that due to spark transmitters, but is still a source of annoyance when such a transmitter is very close to you. It would require a specially constructed and shielded receiver to tune out a 50-watt C. W. transmitter on 200 meters within a quarter of a mile of a receiver set for 360 meters; while if the transmitter is much closer than this the case would be more difficult and require very special precautions and ability on the part of the person handling the receiver. Should it be impossible to eliminate such interference by the methods described later on, efforts should be made to learn the identity of the interferer, and to persuade him to cease transmission during broadcasting hours.

Single Circuit and Two Circuit Regenerative Tuners

In order to receive radio signals, the reader has no doubt learned that it is necessary to put up an antenna and connect to it a receiving set containing certain pieces of apparatus for "tuning." Every radio station sends out electric waves of a certain size; the size of the wave is specified by what we call its "wave length," which is the distance from the crest of one wave to the crest of the next. The broadcasting stations send out waves of 360 or 400 meters in length (a meter is about equal to a yard), and in order to receive these waves with best efficiency, we connect into the antenna certain adjustable devices called "variable inductances" (also known as variometers), "variable condensers," or both. An inductance is a coil of wire, a variable condenser a set of flat metal plates which may be rotated between other flat metal plates. A variometer consists of two coils of wire, one of which may be rotated within the other, connected together. In the "RC" tuner a variable condenser and variometer are mounted on a common shaft, while in the "Aeriola Senior" the condenser is fixed and only a variometer is supplied. By connecting the antenna to these variable devices, adjustments may be made on them which cause the antenna to be tuned to any desired wave length.

In "regenerative" receivers, a "tickler" is added to the above elements. The function of the tickler is to provide additional selectivity and sensitiveness; it has nothing to do with tuning. It usually consists of a rotatable coil of wire mounted near the variometer, and, by turning it, various degrees of sensitiveness are obtainable. There are several kinds of regenerative receivers, the principal ones being called "single circuit" and "two circuit" tuners.

The "single circuit" tuner is illustrated in the wiring diagram of figure 1. It is called "single circuit" because only one tuning circuit is provided, namely that for tuning the antenna.

Now, it is a characteristic of regenerative receivers that their sensitivity and selectivity are dependent on the strength of the signal which is sent into the vacuum tube; this peculiarity results from the behavior of the vacuum tube when in the regenerative state. The strength of signal depends on the height of the receiving antenna and the distance of the transmitting station (as well as its power). These two factors are both of equal importance; for a transmitting station close by, and a small receiving antenna, the strength of signal applied to the tube may be no greater than that obtained from a distant station on a large antenna. However, the regenerative vacuum tube has its highest selectivity and sensitivity when the signal applied to it is very weak. This may be demonstrated most easily with a single circuit tuner by noting that on a large antenna the signals from nearby stations can be increased only a little by varying the tickler, while signals from distant stations can be brought up from inaudibility to good strength.

There is a way of securing this necessary condition of weak signal, even on nearby stations, and upon large antennas, by the use of so-called "two-circuit tuners." Such a tuner is illustrated in the wiring diagram of figure 2. Here there is an inductance and variable condenser connected to the antenna for tuning it; but there is also a second circuit provided, connected to the vacuum tube, the inductance of which is placed in an adjustable relation to the antenna inductance. It may be rotatable, or movable with respect to its distance from the primary (or antenna) inductance. As this coil's position is varied, more or less signal strength may be passed from the antenna circuit to the vacuum tube through the secondary circuit. We thus arrive at a receiver in which strong signals from nearby stations may be cut down before being applied to the tube, by suitable adjustment of the relation of these two coils. Then the tickler coil may be brought into action, the sensitiveness and selectivity of the set being fully realized.

The two circuit tuner obviously is more difficult to adjust than the single circuit. Two circuits have to be exactly tuned, the "coupling," or relation between antenna and secondary inductances, properly adjusted, and then finally the tickler adjustment made. All of these adjustments usually react on each other, so that the handling of a two circuit regenerative tuner requires some skill and experience. It has only the advantage of the possibility of adjusting the strength of signal fed to the vacuum tube to a point of sufficient weakness; however, this same advantage can be realized with the single circuit tuner when necessary, by methods described below.

Short Antennas for Single Circuit Tuners

As stated before, the strength of signal applied to the vacuum tube in a single circuit set depends on the size and height of the antenna. Therefore, by making the antenna short and low, we may secure very weak signals even from nearby stations. These weak signals when applied to the tube, may be effectively increased to good strength by regeneration, and when the set is in this condition it will be as selective as a two-circuit or any other kind of tuner.

A point I wish to emphasize is that by regeneration we can take a signal which has been made weak by the use of a small antenna, and bring it back to practically the same strength as would be obtained with a large antenna with the same set. But the important difference in the two cases is that in the former case the tube has been "forced to work," as it were, by regenerating fully, and therefore the receiver is in a sensitive as well as a selective condition; while in the latter case, the strong signals do not permit the tube to "exert itself," so that it cannot be brought into a properly regenerative state.

It is important, therefore, to have available a small antenna, for receiving nearby stations. Within distances of the order of 20 miles, a wire run a foot or so from the ceiling, indoors, and 25 feet long, will be sufficient; it may be double cotton covered No. 28, and will be practically invisible. If the signals have been weakened sufficiently by this means, it should be possible to separate two stations from each other differing

by wave lengths of 20 or 30 meters. With skill, one can separate stations only a few meters apart. For example, in localities where stations send simultaneously on 360 and 400 meters (as in New York City), there should be no trouble whatever in separating these from each other.

Should the signals on an antenna of this sort be found still too strong to permit of adequate selectivity, it may be reduced to any desired size, even a few feet sufficing sometimes. However, when antennas less than 20 feet in length are employed, it may be found that it becomes impossible to tune the antenna; this is due to the fact that the tuning elements in the receiver are not designed to tune such very short antennas. In this case, a remedy will be secured by connecting a condenser having a capacity of .0005 mfd. across the antenna and ground binding posts of the receiver.

On such antennas it will often be found possible to receive very distant stations through local ones, in a manner impossible on a large antenna except with two-circuit tuners. A large antenna, outdoors, may be retained in order to receive very distant stations after the local ones have shut down.

CIRCUITS FOR LARGE ANTENNAS

If the reader is interested in experimentation, he may try one of the following schemes in receiving on an outdoor antenna (say 75 or 100 feet long).

The first method is one suggested by Mr. R. A. Weagant. It consists simply in placing a fairly large condenser across antenna and ground binding posts. Various condensers may be tried, starting in with .001 mfd., and progressing to .01 mfd. in three or four steps. With each value of capacity tried, the reader will find that his set tunes to a given station at points lower and lower on the scale; at the same time it will be noted that increasing tickler adjustment will be required to obtain satisfactory signal strength, but that at the same time the selectivity of the set is greatly increased. The action of this circuit is partly due to weakening of the signal applied to the tube in a manner similar to that of the small antenna, and partly to more complex tuning characteristics which are imparted to the receiver by this connection.

Another method, which is applicable only to eliminating one or more definite undesired stations (for example, a local broadcast transmitter, when listening for distant stations) consists in the insertion of what are known as "wave traps" in the antenna circuit. A wave trap is a circuit which can be tuned so as to cut out signals on a given wave length, and consists of an inductance connected to a variable condenser, coupled to (placed near) a coil consisting of a few turns of wire connected into the antenna circuit. By tuning the condenser and simultaneously adjusting the position of the coils with respect to each other (if necessary, putting one coil inside the other) an adjustment will be found by means of which the interfering station's signals are eliminated without any influence on the signals of the desired station; provided they are on sufficiently different wave lengths. The scheme will work readily on stations 40 meters apart, and with some skill on stations much closer together.

The circuit shown in figure 3 indicates the manner in which a wave trap is connected into the antenna. The antenna coil consists of about 20 turns of No. 18 double cotton covered wire wound into a coil 4 inches in diameter and taped together. The trap coil consists of about 60 turns of No. 22 double cotton covered wire wound on a form 3 inches in diameter, while the variable condenser may have a maximum capacity of .0007 or .001 mfd. The antenna coil may be placed flat on the table and the trap coil flat end on the table, so that it may be brought near to, partly over, or entirely inside the antenna coil; it may also be spaced vertically from the latter by wooden blocks, the axes of the two coils coinciding. If with one coil inside the other no marked effects are secured, the antenna coil may be replaced by the same number of turns wound directly on the trap coil, over its own winding. By experimenting with the number of turns required in the antenna coil, it will be found that perhaps more or less than 20, depending on the antenna, will give best results. More than one trap circuit can be used, each similarly connected, and each set to eliminate some given station.

CONCLUSION

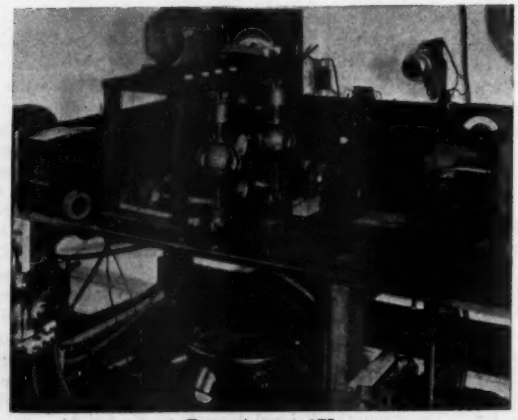
The reader is urged to try the use of a small, short antenna, if he is experiencing difficulties from interference between broadcast transmitting stations well separated in wave length, or from amateur or commercial transmitters on widely different wave lengths. "Birdies," and whistles due to interaction of broadcast transmitters on adjacent wave lengths, cannot be eliminated by any receiver, if radiophone reception is desired. If the reader is inclined toward experimentation, he may try the condenser shunt across antenna and ground, or wave traps for the elimination of one or more undesired local stations.

Trans-Atlantic Work of 2ZL

AN unprecedented record for trans-oceanic work by short-wave low power stations has been made during this winter by 2ZL station, at Valley Stream, L. I.

It will be recalled that during last November this station successfully transmitted messages to England at the first attempt on a definite pre-arranged schedule for the first time since amateur stations have been engaged in trans-Atlantic work.

During the recent trans-Atlantic tests of the American Radio Relay League the station, although not operated regularly, was reported from England, France, Switzerland and Central America.



Transmitter at 2ZL

Since the trans-Atlantic tests it has been operated regularly in a series of experiments in conjunction with British radio engineers, to determine the amount of variation in short-wave signals at different times of night and under the varying conditions of North Atlantic weather. In these experiments the transmitting wave-length has been progressively reduced and successful transmission of complete messages accomplished on wave-lengths as low as 190 meters.

On Saturday night, January 13, several messages, totaling approximately 350 words, were transmitted and successfully received at Manchester, England. Confirmation of the reception came in a commercial radiogram from W. R. Burne, British 2KW, who reported complete reception of everything transmitted on the night of the 13th.

On the night of Tuesday, January 16, the station again transmitted about 300 words, made up of private messages, and complete reception of everything transmitted was again reported by Mr. Burne, at Manchester.

Several hundred words were transmitted and received at Manchester on subsequent nights, although a falling off in signal strength was reported during the latter part of January, and finally the signals failed entirely to get over to England.

As a whole, the experimental work carried on indicated that reliable trans-oceanic work by low-powered, short wave stations can be carried on only for about two months of the year, in general between Nov. 15 and Jan. 15.

Two-way trans-Atlantic work between American and English amateur stations, has not yet been successfully accomplished, however, owing to the great amount of interference on this side from amateur stations, which operate continually. Signals were reported during the trans-Atlantic tests and since then, but the great amount of interference prevailing has prevented anything in the way of consecutive reception.

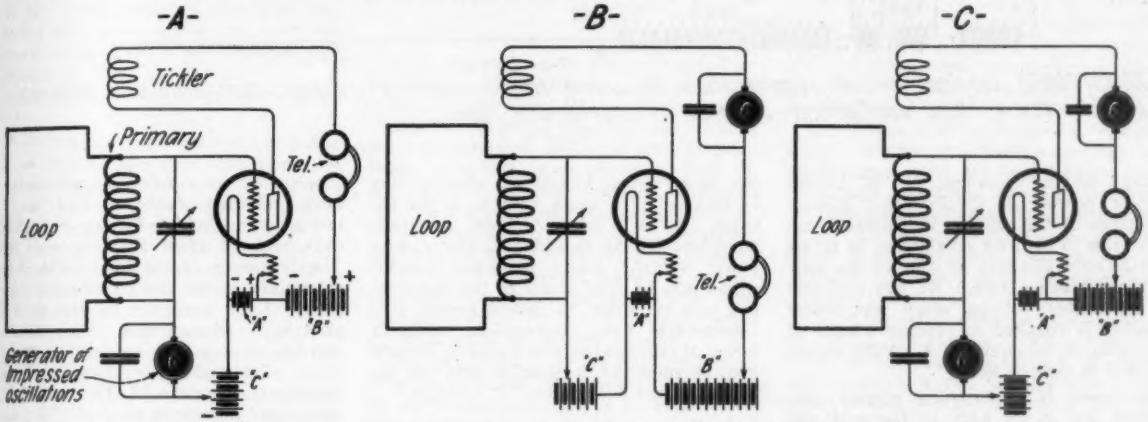
When a receiver which is sensitive enough to bring in European amateur signals is used, it also brings in so much interference from American amateur stations, some as far away as the Pacific Coast, that the weak signals from Europe are hopelessly lost. When a temporary lull in local interference occurs, as it sometimes does, it is possible to hear English or French signals, but not for a sufficient time to make consecutive reception possible. It seems, therefore, in view of the prevailing conditions in this country, that two-way trans-Atlantic work will be a rare accomplishment.

Some Practical Super-Regenerative Circuits

By Abraham Ringel

EVER since Armstrong first revealed the principles of super-regenerative circuits, a vast army of experimenters all over the country has been tirelessly attacking the problems involved in many different ways. The writer wishes to present just a few practical circuits—so that the average amateur will be able to construct and experiment with them with the facilities at hand. In the circuits illustrated, the variation frequency is applied both to grid and plate of the regenerative tube, radio frequency amplification is used, new filter arrangements are described; different forms of circuits for the oscillator which produces the variation frequency, and above all, the constants and dimensions of the various coils, condensers, batteries, etc., that are used, are given in detail. The main feature and theory of super-regeneration was quite fully described by the author of this article in the July, 1922, issue of THE WIRELESS AGE.

Just before oscillations occur in an ordinary regenerative receiver the signal is very loud—but this condition is unstable. In super-regenerative circuits, by means of an exceedingly clever trick, it is possible to increase the tickler coupling beyond the normal oscillating region and obtain the greater amplification then available—but without getting any oscillations. Armstrong has discovered that these incipient oscillations can be damped out, either by varying the grid voltage, or the plate voltage, or both, at some frequency which is less than that of the received signal. These methods are illustrated in figure 1.



Circuits illustrating essential features of super regenerative receivers.

Figure 1

The circuit of figure 1A shows how super-regeneration is effected by varying the grid voltage of the regenerator tube. Signals are picked up by the loop which is tuned by the combination of condenser and primary coil and amplified by regeneration; G is an alternating current generator whose frequency is, let us assume, 10,000 cycles per second. The tickler coupling is increased beyond the oscillation point; when the impressed voltage from G is such as to make the grid more negative, the received signal is built up to an extremely large value. Free oscillations also start in the tuned circuit, of the same frequency or wave length to which the circuit is tuned and built up. But the signal amplitude is very much larger than that of the free oscillations, because the former starts at a definite voltage, which is of the order of one hundredth of a volt, while the latter start from practically zero. Before the free oscillations have an opportunity to increase to any appreciable value, the generator G reverses in voltage and tends to make the grid positive. This causes a current to flow from filament to grid—abstracting this energy from the grid circuit. Thus, both the received signal and the free oscillations are damped out. But during the negative grid periods, the amplification is very great. Generally, the "B" battery should be at least 100 volts. In this case a grid or "C" battery is necessary—the voltage of which should be variable.

In figure 1B, the generator G is shown in the plate circuit. In this case, when the generator voltage is such as to increase the "B" battery voltage, regeneration is carried beyond the oscillation point, since the effect of the increased plate voltage is to lower the internal filament-plate resistance of the tube. Then we obtain the effects mentioned above: (1) building up of signal, (2) incipient free oscillations. The signal is greatly reduced and the free oscillations choked off when the generator reverses its

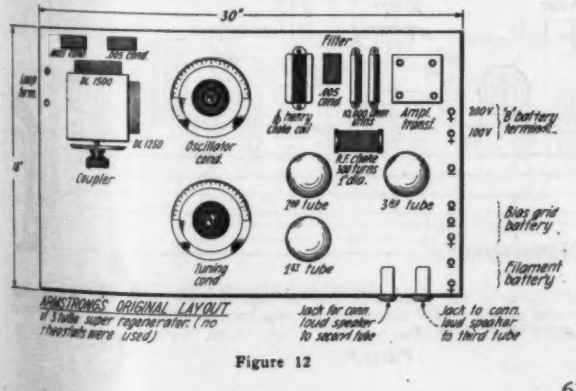


Figure 12

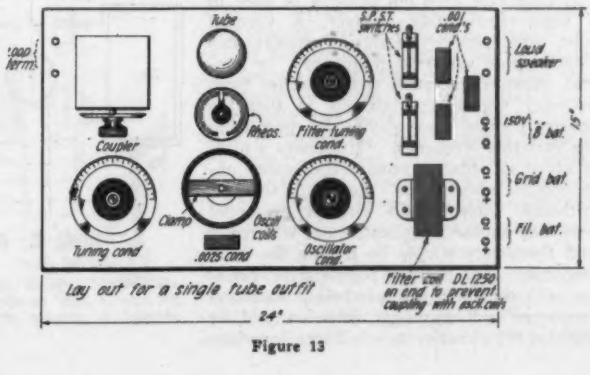
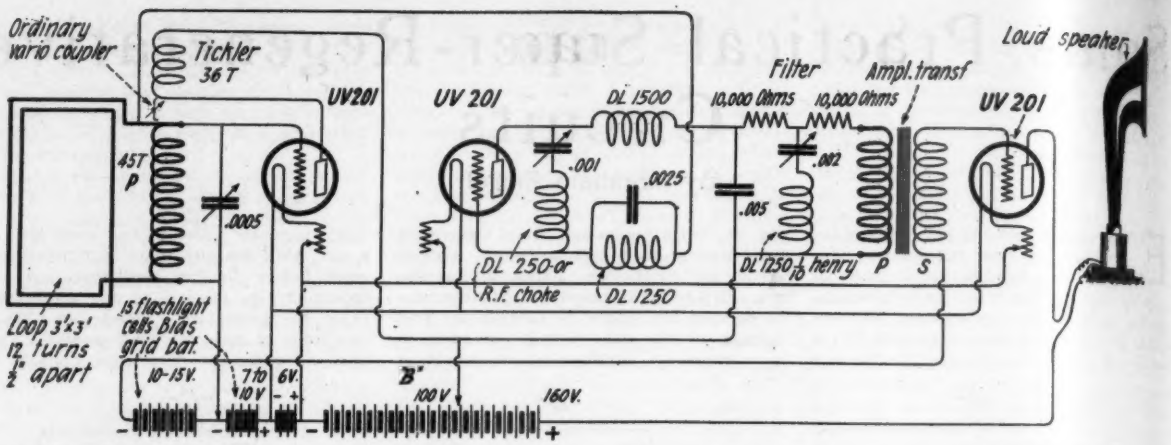


Figure 13



ARMSTRONG'S original circuit regeneration by using tickler coupling .. Super regeneration is effected by impressing local oscillations on grid of regenerator tube..

Figure 2

voltage, tending to reduce the "B" battery voltage, because of the increased internal resistance of the tube. The amateur can prove this to his own satisfaction by trying first 22 volts and then 45 volts on the plate of a regenerative tube. He will find that at the higher voltage, much less tickler coupling is required to produce a state of oscillation in the circuits. A UV201 should be used in such a test.

In figure 1C, alternating current generators are shown both in the grid and plate circuits. They should be so synchronized that, when the generator G in the grid circuit tends to make the grid negative, generator G^1 in the plate circuit should increase the plate voltage; and when G makes the grid positive, G^1 should lower the plate voltage. Under the first conditions, incoming signals are super-regenerated; in the the latter case they are weakened and the incipient oscillations damped out. Of course both generators should be of the same frequency.

The reader may then ask: "But will not the super-posed frequency distort the received signal?" The answer is: "It will if this frequency is anywhere within the audible range, i. e., from 200 to 5,000 cycles. If it is within these limits a whistling note will always accompany the music. If it is above 5,000 cycles, it will barely be audible, because telephones and loud speakers do not easily respond above this frequency. Even at high frequencies this whistle is likely to be quite pronounced and electrical filters are necessary to eliminate it.

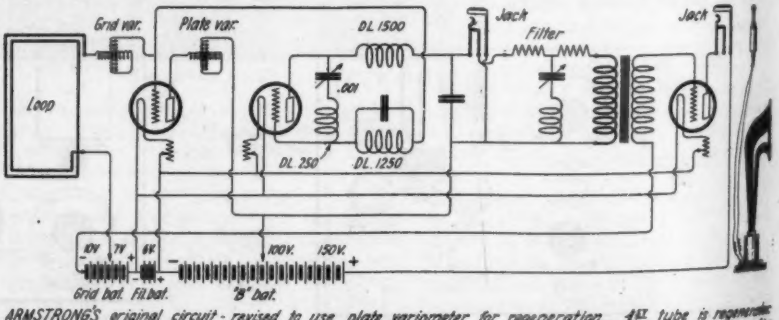
A generator need not actually be used in a super-regenerative receiver. A vacuum tube, with properly designed circuits, can produce this variation frequency. In general, super-regenerative circuits differ from ordinary regenerative circuits in that the former contain some device for producing the variation frequency. Oftentimes a filter is added in order to remove this rather objectionable noise from the loud speaker. Although some of the circuits presented here may appear complicated, one will really find them very simple by tracing the main features: (1) simple regenerative hook-up, (2) oscillator for producing variation frequency and impressing same on grid, or plate of regenerative tube. These functions may be performed in separate tubes, or may be included in a single tube as in the so-called "flivver" circuit. Audio frequency amplification may be added to give greater power output. Radio frequency amplification may be used ahead of the regenerative tube in order to obtain greater DX. Innumerable filter combinations, different forms of regenerative and oscillator circuits may be employed, a separate tube for detection, in the well-known "57 varieties."

ARMSTRONG'S ORIGINAL CIRCUIT

The circuit which was demonstrated by Armstrong before the Institute of Radio Engineers, is shown in figure 2. An examination of this circuit shows the first tube to be the regenerator, feed-back being accomplished by means of the tickler coupling. The second tube acts as oscillator (about 10,000 cycles per second) and also as detector. Oscillations in this tube are produced by means of the condenser between grid and plate, which provides the necessary feed-back coupling, and are applied to the grid of the regenerator tube. This corresponds to the system shown in figure 1A, with the exception that the oscillator tube behaves as detector as well. From the plate circuit of the latter, a third (amplifier) tube is fed by means of an audio frequency amplifying transformer.

In the case of the first tube, the connection of the loop to the tuned grid circuit may seem peculiar, but it is of great aid in stabilizing operation. An ordinary vario-coupler, with approximately the number of turns indicated should be used here. A two-coil mounting for Remler, or duolateral coils, each of about 50 turns, may serve. The frequency of the local oscillations is determined by the size of coils and the capacity of the condenser between grid and plate in the second tube. Since there are currents of very high frequency in the grid circuit of this tube (the detector), a by-pass condenser across the DL 1250 coil of .0025 microfarad capacity is required. To prevent the direct passage of these currents through the condenser to the plate circuit, a choke coil must be inserted in this lead; this choke may be a DL 250 coil, or else consist of about 300 turns of No. 22 or No. 24 double cotton-covered wire wound on a spool one inch in diameter and three inches long.

The filter circuit consists of a pair of 10,000-ohm resistance units—(this value need only be approximate)—and a series-tuned circuit connected as shown. Armstrong used an iron core coil for the 0.1 henry choke, but a duolateral coil 1250 is just as effective, the only precaution being that it be removed from the magnetic field of the other oscillator coils. This filter is necessary only when the third tube is used and merely prevents the oscillations of the variation frequency from overloading the grid of the amplifier tube and destroying the amplification. If only the first two tubes are used, the filter may be removed and the loud speaker inserted in place of it. The .005 blocking condenser should remain in the



ARMSTRONG'S original circuit - revised to use plate variometer for regeneration.. 1ST tube is regenerator 2ND tube is local oscillator and detector.. 3RD tube is audio frequency amplifier.. Super regeneration secured by varying grid potential on 1ST tube..

Figure 3

circuit. Figure 3 illustrates how this is done with jacks.

Best results are obtained with plate voltage of 100 volts on the first and second tubes and 200 volts on the third. In order to work on the straight line characteristic and avoid excessive grid current, a bias battery is necessary for the grids. This should preferably be variable, about 7 or 10 volts will be required for the first two tubes and 15 or 20 volts negative on the last grid. Fifteen small flashlight batteries, connected in series, and with two tap switches so arranged as to give any desired voltage are admirable for this purpose. Tapped "B" batteries can be used here.

The layout of the original set-up used by Armstrong is shown diagrammatically in figure 12. A pine board, ½ inch thick, and 18 inches wide by 30 inches long, with two coats of orange shellac is ideal for mounting the apparatus.

The operation of this set is somewhat as follows:

(1) Adjust condenser between grid and plate of second tube until oscillations of variation frequency are heard.

(2) Tune receiving condenser and vary tickler coupling to obtain desired signal.

(3) Increase tickler coupling as far as possible without obtaining squealing noises.

(4) Retune with condenser for maximum signal.

(5) Rotate loop for maximum signal.

(6) Vary frequency of local oscillator until loudest signals are obtained.

(7) Adjust grid bias battery until best results, both as to loudness and clearness of tone, are secured.

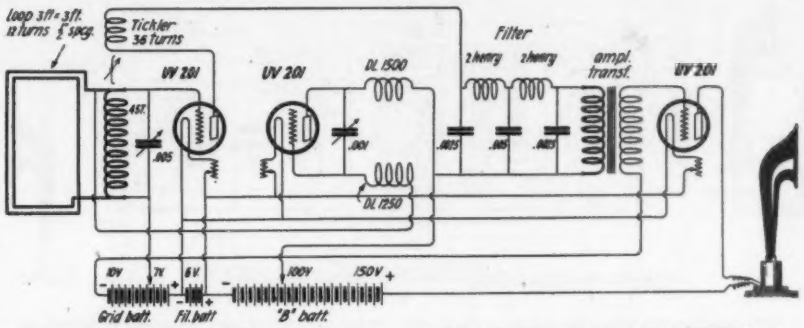
(8) Adjust filter circuit and retune slightly.

These adjustments are not at all complicated. Once the grid batteries, oscillator and filter are of proper values, they are left alone. In that case, there are only three controls remaining, namely: (1) Tuning. (2) Tickler coupling. (3) Rotation of loop.

Before the amateur goes ahead with the construction of the other sets described here, the writer would urge him to first build the one already mentioned, and study its vagaries until he is thoroughly familiar with its actions. Then let him progress to the others—single tube or "flivver" circuit, and combinations with r. f. amplification.

SLIGHT VARIATIONS OF ARMSTRONG'S ORIGINAL CIRCUIT.

In figures 3, 4, and 5 are illustrated circuits in which there are slight variations from the one shown in figure 2.



Another 3-tube circuit employing low pass filter... 1ST tube is regenerator and detector, 2ND tube is local oscillator, 3RD tube is audio frequency amplifier. Super regeneration obtained by varying grid potential of 1ST tube...

Figure 4

(A.) Regeneration by Plate Circuit Tuning—Figure 3 is essentially the same circuit as figure 2, the main difference being in the method of obtaining regeneration. Here a plate variometer is employed instead of the tickler coupling of Armstrong's hook-up. Note that if the loud speaker is plugged into the first jack the filter is not in use. If the additional stage of audio frequency amplification is required, the filter must be used in order to prevent the strong oscillation frequency from plugging the tube. The operation of this set is practically the same as the original set described above.

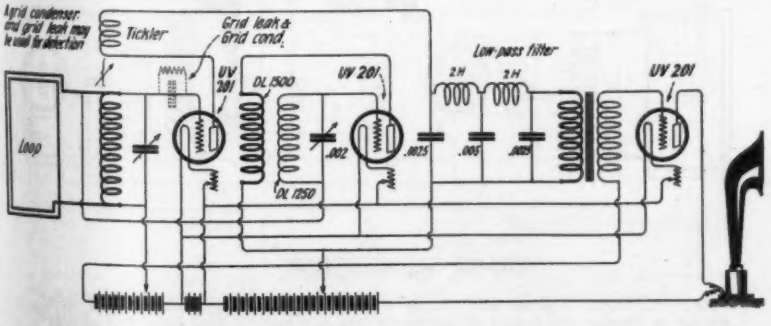
The first tube acts as the regenerator and super-regeneration is effected by applying the oscillations generated by the second tube to the grid of the first. When the phase of these oscillations is such as to make the grid negative, the signal is amplified tremendously. Free oscillations also commence in the loop circuit. When the oscillations reverse, the amplification is greatly diminished because of the positive bias on the grid and the free oscillations are choked off. The oscillator tube is also the detector; it is, in general preferable to use this tube rather than the first, because a certain amount of amplification is gained thereby. With such large amounts of energy as are handled here, it is better to use a bias on the grids in order to obtain rectification, rather than the customary grid condenser and grid leak.

(B.) Use of First Tube as Regenerator and Detector—In figure 4 is illustrated a circuit, which is identically the same as figure 2, except that the regenerative tube is used also as the detector, and a different form of filter is used to eliminate the objectionable variation frequency from the audio frequency amplifier. The oscillator circuit is much simpler, the choke coil between grid and plate of the second tube being no longer essential, similarly, the .0025 condenser shunting the 1,250 coil is also unnecessary.

The filter is of the type called a "low pass filter." Such a combination of coils and condensers permits the free passage of all frequencies below the "cut off" frequency, and attenuates all frequencies above this value. The cut-off frequency for the filter shown is approximately 4,000 cycles. The variation frequency, which is about 10,000 or 15,000 cycles, is far above this, and is reduced to a small fraction of its value at the amplifying transformer. All frequencies below 4,000 cycles pass through practically unhindered—and this enables the desired speech or music to be received without distortion. The series coils are of 2 henries inductance and the shunt condensers of .0025, .005 and .0025 microfarad capacity. These values need be accurate to only about 10 or 20 per cent—and any mica condensers on the market are suitable for use here. The 2-henry coils are at present not so easily procurable; either air or iron core coils may be used, but iron core coils are better because they can be made more compact. By winding 3,500 turns (approximately) of about No. 36 or 38 enameled or single-silk covered wire on an iron core ½ inch in diameter and 2½ inches long, the inductance will be approximately 2 henries. The core may consist of a bundle of No. 22 iron wire wrapped tightly together, and of the dimensions described.

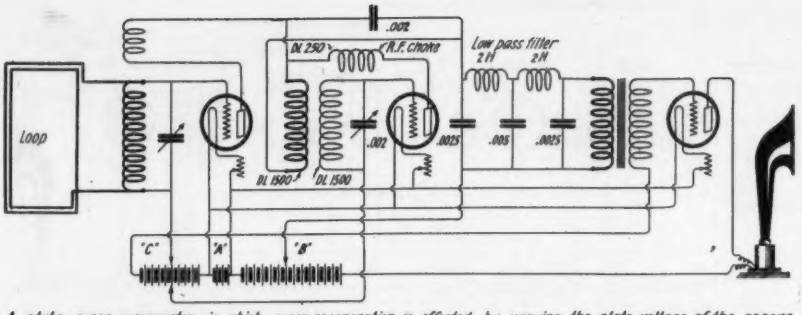
The operation of this circuit is in no way different from those already shown, and the same procedure is followed in tuning and adjusting the various elements until best signals are obtained.

(C.) First Tube as Regenerator and Detector; Different Circuit for Generating Variation Frequency—The circuit in figure 5, in comparison with figure 4, is different only because another type of oscillating circuit is employed to produce the variation frequency. Previously, we have had the feed-back by means of the condenser between grid and plate of the second tube. Now we employ inductive coupling between the coils themselves. This coupling need not be variable. The two coils are simply taped together. If the amateur tries this method and does not succeed in getting the circuit oscillating, it is only because the leads on one of the coils have not been properly connected—and on interchanging them, oscillations should commence. The frequency is determined by the inductance of the 1,250



A circuit similar to Figure 4 except that a different oscillating circuit is used in the second tube...

Figure 5



A 3-tube super regenerator - in which super regeneration is effected by varying the plate voltage of the regenerative tube. Other circuit constants same as before... 1st tube is regenerator and detector... 2nd tube is local oscillator... 3rd tube is audio frequency amplifier...

Figure 6

coil and the capacity of the .002 microfarad condenser that shunts it and may be varied at will by altering the condenser capacity.

As in the arrangements described above, super-regeneration is here accomplished by applying the variation frequency to the grid of the regenerative tube, making it alternately positive and negative.

The first tube also functions as the detector. A grid condenser of .00025 microfarad capacity and a grid leak of 2 megohms resistance can be used here instead of the bias battery. The behavior and operation are the same as described above and need no further mention.

Circuits Differing from Armstrong's Original Set-Up.—The circuits described above are all based on Armstrong's set-up, demonstrated before the Radio Club of America and differ from the original in just a few minor details, such as oscillator circuit, regenerative circuit, and filter devices. Super-regeneration in all of them is effected by applying the local oscillations to the grid of the regenerative tube.

In some of the arrangements described in this section, this frequency is applied also to the plate—and in the case of the "flivver" combination, to both grid and plate. Combinations with radio frequency amplification ahead of the super-regenerative are also used. The purpose of such an arrangement being to get greater distances of reception and also to prevent the highly undesirable re-radiation from the loop.

Super-Regeneration by Varying Plate Voltage of Regenerator

In figure 6 is shown a practical circuit for obtaining super-regeneration by impressing the locally generated variation frequency on the plate of the regenerator tube. In this circuit, the first tube acts as both regenerator and detector, the second as oscillator at 10,000 or 15,000 cycles, and the third as audio frequency amplifier.

It will be noted that the plate circuit of the regenerative tube is completed through the plate coil of the oscillator; any variation in voltage across the coil of the oscillator is bound to affect the effective plate voltage on the regenerative tube. A blocking condenser of .001 microfarad capacity shunts the 1,500-turn coil of the oscillator in order to provide a by-pass for the radio frequency. The oscillating circuit is practically the same as in figure 5 and the same precautions should be taken in order to obtain oscillations.

When the oscillations in the plate coil are such as to increase the plate voltage, signals are then super-regenerated. During the other halves of the cycle, the plate voltage on the regenerative tube is diminished and consequently the signal weakened and incipient free oscillations are damped out. The rest of the set shows the usual filter followed by the audio frequency amplifier. The operation should be no more difficult than that of the receivers already described.

Two-Tube Super-Regenerative Receiver With Tuned Rejector Filter

Figure 7 illustrates a two-tube combination. The first acts as regenerator and detector, and the second as oscillator, the oscillations being impressed on the grid of the regenerative tube. Regenerative and oscillating circuits are the same as those described in figure 6. Note that no audio frequency amplification is used, the loud speaker or telephones being inserted in the plate of the detector tube. The filter is not absolutely necessary and may be dispensed with if the whistle is not too objectionable. In case one is used, any of the types previously described are suitable. A simpler arrangement would consist of a condenser and a one-tenth henry inductance in series across the loud speaker. When this is tuned to the 10,000 or 15,000-cycle oscillations, it will provide a shunt for the oscillations and a very small portion will find their way to the loud speaker. The two-tube circuit will give sufficient signal strength to operate the loud speaker, only when a short distance from a broadcast station. For distances greater than fifteen or twenty miles, a single stage of audio frequency amplification may be added. With a set in proper working order, containing three tubes, loud speaker operation can often be obtained when using only the vario-coupler to pick up the signal. This is the case, of course, only when the station is of the order of five or ten miles away.

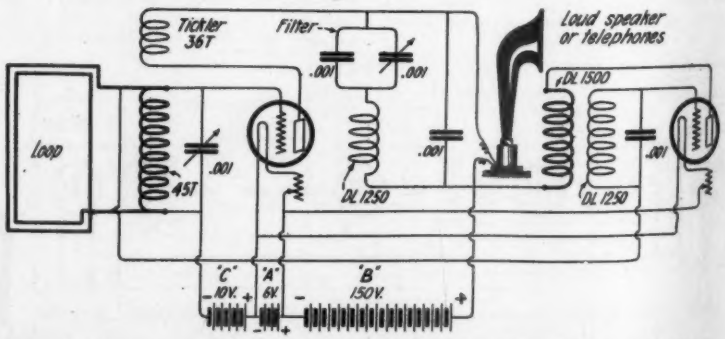
The various constants of the coils and condensers and batteries is indicated in the diagram. The oscillator coils should be taped together and the same procedure as described above applies in order to get the circuit oscillating. The operation offers no unusual difficulty—the only critical adjustment being in the "C" or grid battery, where a compromise must be made between clearness and purity of tone on the one hand, and intensity on the other.

Single Tube Super-Regenerative Receiver "Flivver" Circuit

In figure 8 is described the much advertised single tube circuit. Here all three operations required of a super-regenerative receiver are performed by a single tube, namely, regeneration, oscillation at 10,000 or 15,000 cycles, and rectification, or detection. Since the characteristics of vacuum tubes are such that the most efficient operating points for regeneration or oscillation are different from the best detecting points, it is obvious that the single tube outfit is not inherently very good. As a matter of fact, the value of the grid battery is quite critical and a good deal of experimentation must be done in order to determine the correct value. Changing the tube, or changing the plate voltage necessitates a re-adjustment of this important factor.

The regenerative circuit is generally the same as has been described in the combinations above—as is also the oscillating circuit. Note that a condenser shunts each of the oscillator coils, which provides the by-pass for the radio frequency signal being received. The filter shown here is of the resonant type—although a low-pass filter would be equally effective. If the experimenter so desires, he need not use it at all.

The operation of a set of this sort is bound to be rather a serious undertaking. The extent of variation of the grid voltage or plate voltage must be of proper value compared to the amplitude of the received signal and it is exceedingly difficult to do this with the circuit shown. The grid biasing battery must be of such a value as to effect a compromise between good oscilla-



A two-tube super regenerator - using a tuned rejector - filter. Super regeneration effected by varying grid voltage of regenerator tube 1st tube is regenerator and detector 2nd tube is oscillator...

Figure 7

tion and good detection. The tickler coupling is likely to be quite critical—wide variations in signal strength being obtained with slight variation of the tickler.

For this circuit, the writer would recommend a very hard amplifier tube, possibly a UV202 (5-watt power tube).

Single Tube Super-Regenerator Using Separate Detector Tube

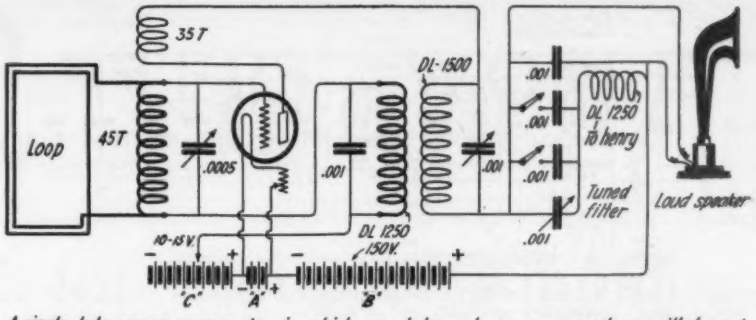
Figure 9 shows a single tube circuit with a few modifications which make it easier to operate. The regenerative and oscillating circuits are unchanged. An additional circuit is coupled to the receiving primary coil and applied to the grid and filament of another tube which acts as a detector. The latter may then be easily adjusted to a point on the characteristic curve where good rectification is obtained. By varying the coupling between regenerative tube and detector, a high degree of selectivity may be obtained. No filter is necessary here since very little, if any, of the audio frequency oscillations find their way to the detector tube, because of the coupling used.

Combination of Super-Regeneration with Radio Frequency Amplification

All the super-regenerative receivers described above have one great failing, namely, the received signal is amplified to such magnitude that serious interference is caused in other nearby receivers by re-radiation from the loop. In some tests made by the writer, he found it impossible to operate another loop receiver, connected to a radio frequency amplifier, about thirty feet away from the super-regenerator. Even tuning the loop used with the radio frequency amplifier was enough to upset the stability of the super-regenerator. It is quite apparent that any device of this nature should not be extensively marketed until this harmful radiation is eliminated The immediate solution is of course the coupling of radio frequency amplification with the super-regenerator. In addition to preventing radiation of any disturbance, it will allow of the reception of greater distances, because of the ability of radio frequency amplifiers to reach out for those weak signals which are inaudible on ordinary sets.

Combination of One-Tube Outfit With Radio Frequency Amplifier

Figures 10 and 11 illustrate the method of combining r. f. with super-regeneration. In both cases, the single tube circuit is shown. In figure 10 the radio frequency amplifier is of the tuned circuit type, where the coupling between plate of the radio frequency tube and grid of the regenerative tube may be varied. The grid is tuned by means of a condenser across the secondary coil—and regenerative feed back is accomplished by coupling the plate coil to the secondary. Three coil mountings, using honeycomb, duolateral, Remler, or spider-web coils of approximately the number of turns indicated on the diagram are advisable here.



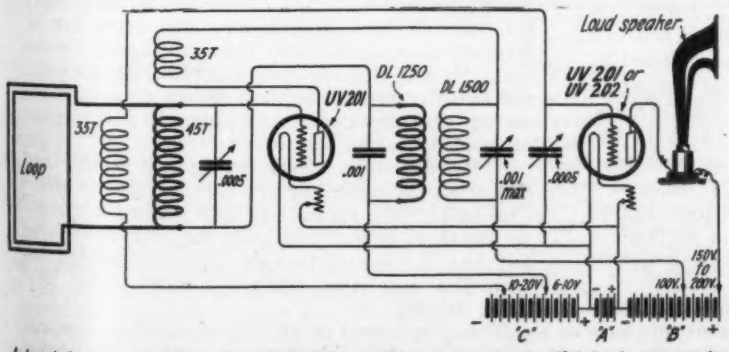
A single tube super regenerator in which one tube acts as regenerator, oscillator and detector.. Super regeneration effected by varying both grid and plate voltage..

Figure 8

The adjustments of a circuit as used in figure 10 are as follows:

1. Tune loop circuit.
2. Tune secondary of regenerator tube.
3. Vary potentiometer of r. f. tube until loudest signals are heard.
4. Adjust tickler coil coupling for optimum signal.
5. Vary grid biasing battery for optimum signal.
6. Go over all the above adjustments until you get the loudest signal consistent with good quality of reproduction.

The circuit of figure 11 is easier of operation than figure 10, since only two controls are required for obtaining the radio frequency signal, namely, tuning the antenna, which may be used instead of a loop, and adjusting the plate variometer in order to obtain regeneration. Otherwise, the other radio frequency adjustments and super-regenerator controls are the same as before. A filter may or may not be used, at the option of the experimenter—but the writer has found that the whistle is exceedingly distasteful to many listeners. Of course, in an experimental set, which will probably be altered from day to day, it is advisable to keep costs down as low as possible and the filter may accordingly be omitted. However, it should be included in the final, finished model.



A two-tube super regenerator in which no filter is required—1st tube is regenerator and oscillator 2nd tube is detector—super regeneration effected by varying both grid and plate voltage of regenerative tube..

Figure 9

Combination of Armstrong's Original Model with Reflex Tube

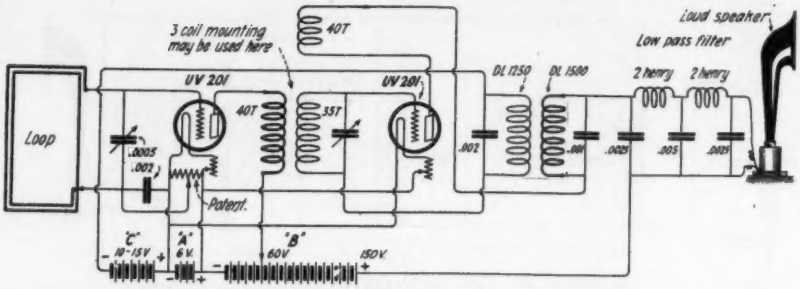
Figure 14 illustrates the use of radio frequency and audio frequency amplification in a reflex stage combined with Armstrong's original set-up. The desired station is tuned in with the loop and amplified at radio frequency by the first tube. By means of the UV1714 transformer (Radio Corporation of America's r. f. amplifying transformer) or by coils described above, the signal is transferred to the grid of the second tube, where it is super-regenerated by the action of either the tickler coil, or plate variometer in conjunction with the local oscillations which are applied to the grid. Signals then pass to the third, or oscillator tube, where they are rectified and made audible. From the last tube, they are fed through a low pass filter (any other type is also suitable) to the primary of an audio frequency amplifying transformer, and from the secondary to the grid of the first tube again. It must be remembered that we are now dealing with audio frequency. This is now amplified by the tube. Telephones or loud speaker are in the plate circuit of the first tube, in series with the primary of the radio frequency transformer. A telephone blocking condenser should be used across the phones in order to by-pass the radio frequency currents.

It is important to note that 80 volts is applied to all three tubes, obviating the use of additional grid batteries. A potentiometer or stabilizer is used in the usual manner with the radio frequency tube.

Conclusions and Recommendations

Because of his relative unfamiliarity with these circuits, the amateur should first start with Armstrong's original set in order to familiarize himself with its actions. From that point let him go on to the more advanced types, ultimately attaining that stage where he adds radio frequency amplification.

In order to get large outputs from the systems described, fairly high plate voltages are



Combination of radio frequency amplification and super regeneration... 1ST tube is R.F. amplifier 2ND tube is super regenerator, oscillator and detector...

Figure 10

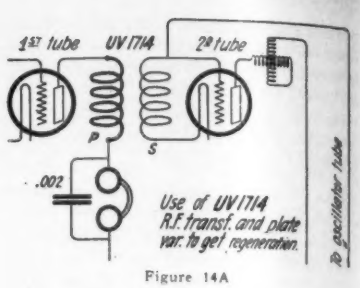
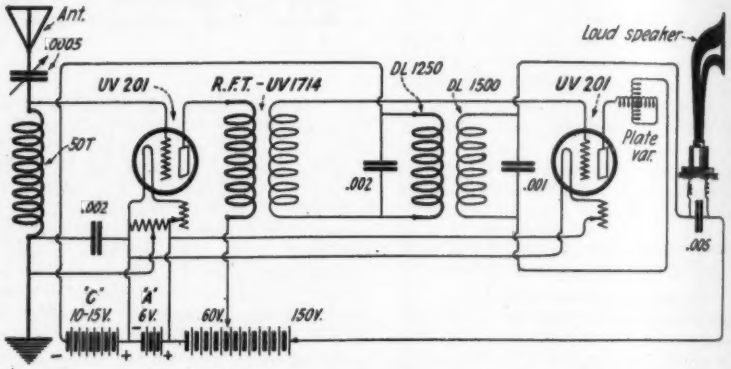


Figure 14A

necessary—and this necessitates the use of good, hard UV201 Radiotrons—and possibly the UV202 power tubes. The experimenter is bound to encounter some violent tube noises at plate voltages of the order of 150 volts with the average receiving tube and will then have to employ the power tubes if he wishes a very strong signal. If he is satisfied with a moderate output, he can use 80 volts on the plates of ordinary UV201's. No grid bias is necessary then—but it is advisable to use a potentiometer across the filaments and connect the slider to the grid circuit. In this way, a continuous variation of the grid voltage can be obtained—from +5 volts positive to about —1 volt negative.

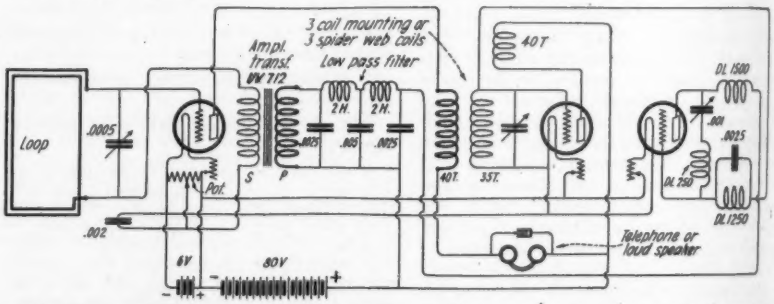
Many amateurs have already reported the reception of stations 1,500 or 2,000 miles away using a three-tube set shown in figure 2. In spite of Major Armstrong's assertions to the contrary, there are numerous reports of reception of distant spark stations, as well as telephone and I. C. W. For continuous waves, an external heterodyne oscillator is necessary, since the circuit is not at its maximum efficiency at the oscillating point.

To obtain greater ranges, radio frequency amplification may precede the regenerative tubes—at the same time eliminating obnoxious radiation. Just as we use radio frequency and audio frequency amplifiers in cascade at present, there is no doubt that the future will bring the use of super-regenerators in cascade.



Method of using super regenerator on antenna by using R.F. amplifier ahead of it to prevent harmful radiation... Filter may be used with loud speaker if too much of whistle is present...

Figure 11



3-tube super regenerator - using one reflex stage... 1ST tube is radio & audio frequ. ampl. 2ND tube is regenerator... 3RD tube is oscillator and detector...

Figure 14

Amateur Phone 9KP Reported from New Zealand, a Distance of 8,500 Miles

THE voice of A. G. Leonard, Jr., owner and operator of Radio Station 9KP, 4801 Woodlawn Avenue, Chicago, Ill., has been reported as heard by L. H. Steele, operator of the Awarua station at Invercargill, New Zealand, a distance of 8,500 miles.

Mr. Steele reports the reception of both C. W. signals and the voice of Mr. Leonard, and his report, which is definite and conclusive, establishes a new record for voice transmission by an amateur station using less than the allowed power input of 1kw for amateur stations and operating on a wave length of 200 meters.

Steele's report describes a performance that comes close to the record for distance transmission on a 200-meter wave. He reports reception of both C. W. signals and voice from station 9KP.

The Awarua operator listed ten other North American stations that he had heard during January and the first week in February, but stated that he received voice signals only from Mr. Leonard's station. He said that the voice was plain, though weak, and that the continuous wave signals were clear and strong. He repeated the messages he had received in substantiation of his report.

A 500-watt tube transmitter is used at 9KP and the set was assembled by Mr. Leonard shortly before Christmas. The station has been worked frequently by amateurs in the East since the first of the year and has carried on two-way voice communication with 2EL and other amateur stations in the New York district.

The circuit used at 9KP is of standard type and is approximately the same as used at 2EL and a number of broadcasting stations. Two tubes are used as oscillators and three as modulators.

EXPERIMENTERS' WORLD

Views of readers on subjects and specific problems they would like to have discussed in this department will be appreciated by the Editor

Rectified A.C. for Plates of Amplifier Tubes

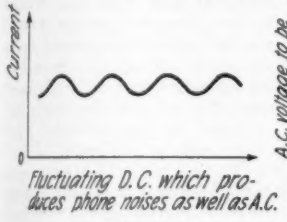
By M. Wolf

(First Prize $25.00)

THE advantage in using A. C. for the plates of amplifier tubes in place of "B" batteries is that it saves renewals of "B" batteries. This in itself would be sufficient to warrant using A. C. if possible. Furthermore, a "B" battery when it is in good condition gives a steady, uni-directional, non-fluctuating voltage, which is necessary for silent operation. However, should any of the cells of the battery go bad there will result a bad voltage variation which will cause all kinds of frying noises in the phones. One bad cell is sufficient reason for discarding a "B" battery, which is another reason in favor of A. C. for tubes.

In using A. C. for amplifier tubes the disadvantage is that the final voltage applied to the amplifier plates may not be a steady non-fluctuating voltage. For successful results the voltage applied to the amplifiers must be a steady, straight line, non-fluctuating voltage, for any fluctuations in plate voltage, no matter how small, will be repeated in the plate current, and a variation in plate current inevitably means noises. Thus if the rectified A. C. is not smoothed out sufficiently well and has ripples in it as in figure 1, a hum will be produced which will be amplified as well as the signal and may be loud enough to counteract signal amplification and swamp the signal. This difficulty can be overcome by proper smoothing out of the ripples and how this is done will be shown in the following paragraphs.

Rectifying the alternating current by means of some form of rectifying tube, as in figure 2, and then smoothing out the rectified wave is not all there is to the problem. The real problem begins after rectification, when the rectified wave has to be straightened out so that there are no kinks in it. The original alternating current wave which has to be rectified before being applied to the tubes is shown by the sine wave in figure 3. This alternating current wave if applied to the amplifier tubes would produce the well known 60-cycle hum. When we rectify the wave by means of the rectifying tube of figure 2 the negative half of the wave is lopped off, since the rectifier does not permit any current to pass from filament to plate, but only from plate to filament. As a result rectification produces the voltage curve of figure 4, which is a direct, pulsating voltage. Now, although the voltage is direct, i. e., always in the same direction due to rectification, it fluctuates in value, and hence will also produce a bad hum in the phones, if it is thus applied to the plates of the amplifier tubes. In other words, rectification alone does not solve the problem. What must now be done, the real problem, is to convert the rectified d. c. pulsating voltage of figure 4 into a non-fluctuating d. c. voltage of figure 5.



Fluctuating D.C. which produces phone noises as well as A.C.

Figure 1

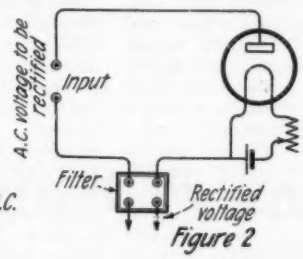
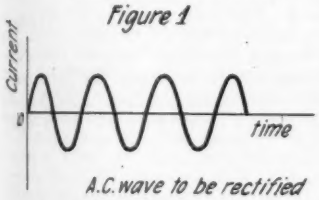
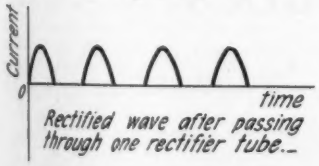


Figure 2



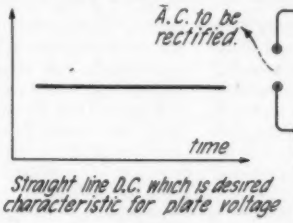
A.C. wave to be rectified

Figure 3



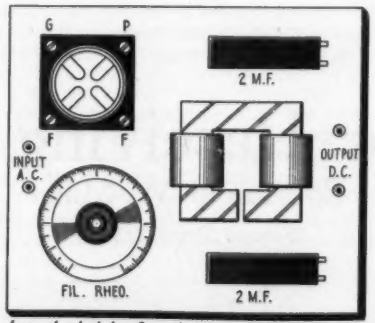
Rectified wave after passing through one rectifier tube.

Figure 4



Straight line D.C. which is desired characteristic for plate voltage

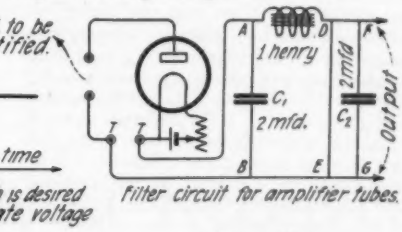
Figure 5



Layout sketch of parts on rectifier and filter panel.

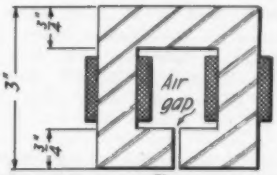
Figure 10

Constructional details, rectifier circuits and graphs



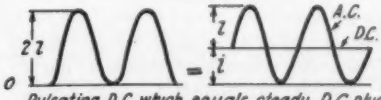
Filter circuit for amplifier tubes.

Figure 8



Filter choke coil.. Built up to 3" sq. section, of transf steel sheets. 1000 turns of № 30 enamel wire, 500 turns on each leg of core..

Figure 9



Pulsating D.C. which equals steady D.C. plus alternating wave..

Figure 6

Figure 7

This can only be accomplished by filter circuits of some sort, and the extent to which the wave is smoothed out depends upon how well the filter circuit is designed. The theory and principle underlying the practice may be explained as follows: Suppose we have a pulsating direct current of maximum value 2i amperes, having the simple sinusoidal form of figure 6. Such a current may be considered to be the equivalent of a steady direct current of value i amperes, upon which is superimposed an alternating current, of sinusoidal form having a maximum amplitude of i amperes also, the axis of the A. C. being considered the straight

d. c. voltage, as shown in figure 7. The voltage wave of figure 6 is equivalent in all respects to that in figure 7. In the same way it can be shown that any kind of pulsating direct current wave is equivalent to a steady direct current component and an alternating current component. If by some means we are able to suppress or eliminate the alternating component of the pulsating D. C. we will have left only the steady, non-fluctuating D. C. to apply to the amplifier tubes. This then is the problem involved after rectification, in order to utilize A. C. successfully on amplifier tubes—namely, suppressing or smoothing out the A. C. component of the rectified wave.

After rectification in the rectifier tube of figure 8 we have at the terminals TT a rectified voltage as in figure 3, which consists of the desired steady D. C. component and the undesirable A. C. component. How can this A. C. component be eliminated without eliminating the D. C. component at the same time? A condenser, we know, will by-pass alternating current but will not pass direct current. Suppose, then, we connect across the terminals TT a condenser C1, which is then in shunt with the voltage across TT. This condenser will not by-pass any of the steady D. C. since it is an insulator to direct currents, but it will act as a conductor for the A. C. component of voltage. Thus there will be a flow of alternating current across the terminals AB through the condenser C1, and hence there will be a drop of A.C. potential across it. Now the magnitude of the alternating current flowing through the condenser C1 depends upon the reactance of the condenser C1. The larger the capacity of C1 the less its reactance, since $X_c = 1/\omega C$. Hence, if we make the capacity of C1 large enough its reactance may be made so small that it will practically short circuit the A. C. component of the rectified voltage. In other words, there will then be no A. C. potential available between points A and B, since the A. C. voltage is short circuited, but the steady D. C. component of the voltage will still be available. Thus if we use a very large capacity across TT we will be able to suppress the A. C. and have available a non-fluctuating D. C. voltage for the plates of the amplifier tubes. This is really the simplest solution if a sufficiently large condenser is at hand.

The writer's experience has been that the size of such a capacity to eliminate the A. C. hum by itself is at least 10 to 15 microfarads which is enormous and certainly not available in most amateur stations. At best there might be found a couple of 1 or 2-microfarad condensers, but seldom, if ever, 10 to 15 microfarads. Hence some further modification of the filter circuit is necessary.

We will therefore consider that C1 is a 2-microfarad condenser in figure 2. Thus although a considerable part of the voltage is absorbed by the 2-microfarad condenser C1, there will still be available at the terminals a small A. C. voltage which will still produce a bad hum. This remaining voltage fluctuation must be suppressed still further. We know that an inductance offers a high reactance to alternating currents, while it may still be designed to have a relatively low resistance to D. C. If then we connect an inductance coil between points A and D in figure 2 this reactance will consume some part of the remaining A. C. voltage, and since the inductance can be designed to have a relatively low resistance there will hardly be any appreciable drop in the steady D. C. voltage. Thus we will have at the terminals D E the steady D. C. voltage intact and a very small A. C. voltage. Whether there is any A. C. voltage left across terminals DE depends upon whether the inductance coil takes up the balance of the A. C. voltage. The larger the inductance the greater will be its reactance, and hence the more voltage it will consume. The best value for this inductance ranges between 1 and 2 henries. In order to make sure that there is no longer any A. C. voltage remaining it is best to use another condenser C2 across FG. This last condenser should also have a capacity of about 2 microfarads, and this will have a sufficiently low reactance to short-circuit any remaining A. C. voltage.

It will be observed that while the A. C. component of the rectified voltage suffers these successive dimunitions, nothing happens to the D. C. component, thus leaving at terminals FG a steady, non-fluctuating D. C. voltage which can be applied to the plates of the amplifier tubes, without interference from any A. C. hum.

In the actual construction of the above rectifier and filter circuit the writer made a complete unit of it. For a rectifier tube the writer used the old type of General Electric Co.'s T tube, which has a conical shaped plate and spiral filament. However he has also tried using an ordinary hard amplifier tube, connecting the grid and plate together, thus making it a two element rectifier. This arrangement gives perfectly satisfactory results. For the two smoothing out condensers C1 and C2 the writer has used Western Electric Co. paper telephone condensers, each having 2 microfarads capacity. These condensers will withstand any voltage which might be used in receiving circuits. For the choke coil L, the writer had to build an inductance having a high inductance. The construction found most suitable is the following: An iron core was used made up of 0.014" transformer steel. Any other thickness near it will be suitable. A closed core as shown in figure 9 was used, this requiring less copper than an open core choke coil. However, a small air gap was left, small enough to insert one or two sheets of ordinary paper. The gap was left, as experience showed, that saturation effects due to the direct current flowing through it were pronounced. The steel sheets were built up to give a cross section of ¾ square inch, the core being 3 inches by 3 inches. One thousand turns of No. 30 enamel wire were used. Smaller wire would be just as satisfactory as the current it carries is extremely small.

(*Continued on Page 72*)

A.C. for Receiving Tubes

By Arnold W. Miller

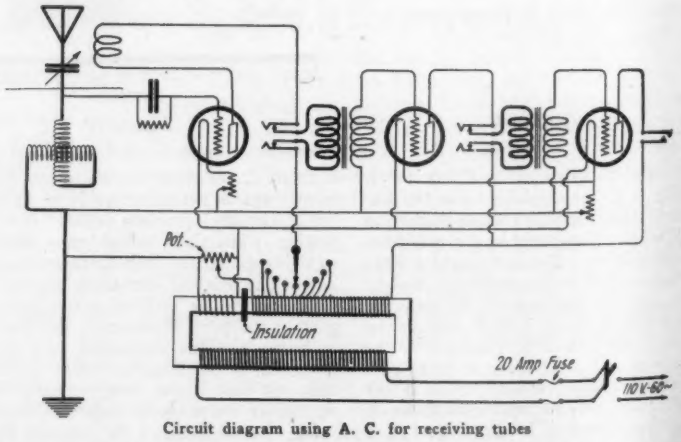
(Second Prize $15.00)

IN providing A. C. for receiving tubes, I use the arrangement shown in the accompanying diagram.

The transformer is no more than a bell ringing device with the secondary changed. The circuit shows the filament leads to the transformer. This winding has fifteen turns. The next winding is for high voltage, detector and amplifiers. When winding this section, tap off every turn from 36 to 45 for variable high voltage detector tap. Add on 115 more turns and bring this lead to the last phone jack. The filament and high voltage windings are not connected on the transformer. They are coupled indirectly by the pointer on the potentiometer, which is parallel to the filament heating turns.

The primary consists of 220 turns guarded with two 20-ampere fuses just before the line-switch. Reverse the input to obtain correct feed back.

I am getting good results with this hook up, considering the endless troubles I had with A and B batteries, and I am sure with a little care in designing it, all THE WIRELESS AGE readers will abandon the use of A and B batteries.



Circuit diagram using A. C. for receiving tubes

Unrectified A. C. for Receiving

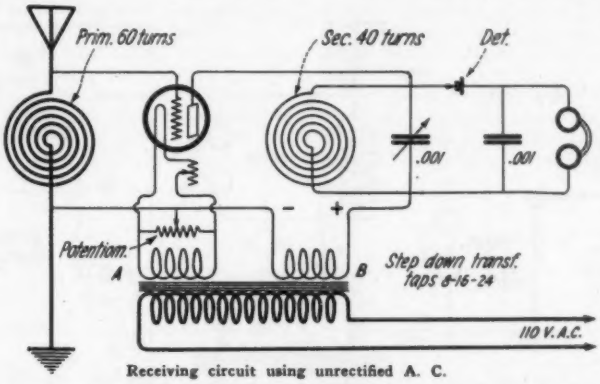
By J. C. Haley

(Third Prize, $10.00)

IT seems to me that a great deal of unnecessary trouble is experienced by amateurs in trying to use A. C. for filament and plate voltages for receiving purposes, judging from my own experience. First, I want to say that much of my own trouble came from a short antenna, and I think many are having difficulty from this source, not being able to put up a long wire. I myself have no room for a wire of the right length, only 45 feet being available. I started with a crystal set, and made four of them before I got results out of a loose coupler, hearing WHB, Kansas City, 64 miles away. Then I built a tube set using spider webs with 60 turns on the primary and 40 on the secondary. These are larger than usually recommended for 360 meters, but they made up for the short antenna.

Now as to A. C., I am using A. C. for both filament and plate, and the hum is not noticeable at all. I use a step-down transformer, tapped at turns 8, 16 and 24, with a potentiometer across the 6-volt section, the sliding arm connected to the negative lead from the 22½ volt section. When this is adjusted correctly the hum is gone. The diagram shows the hook-up.

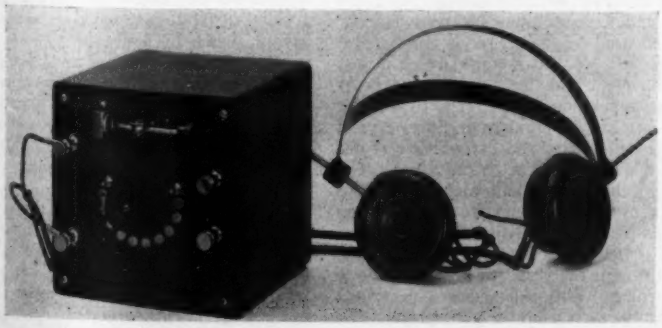
In the tuner is used a tapped primary, with taps on turns 2, 4, 6, 8 and 10, and on 20, 30, 40 and 50. The secondary is not tapped, and is hinged so as to be variable in its relation to the primary. The variable condenser across the secondary has 43 plates, .001 mfd., and there is a fixed phone condenser, .001 mfd., across the phones. A small 11-plate condenser in the ground lead will help some in tuning but it isn't necessary. I can turn off the tube and bring in WHB on the crystal alone.



Receiving circuit using unrectified A. C.

An Efficient Crystal Broadcast Receiver

THE receiver described in this article was designed specifically and solely to receive the broadcasted entertainments. As a result it will be found that this receiver has exceptional efficiency as a broadcast receiver. No attempt was made to cover a band of wave lengths from 200 meters to 2,000 meters or over, and consequently the resistance of the tuning coil employed is at its absolute minimum value. There are also, therefore, no dead end losses to decrease the efficiency of the set. The tapping of the coil has been carefully arranged with a view to securing fairly close tuning where it is most necessary when using the average single wire antenna so commonly employed for broadcast reception. In the following the details of the construction will be given, the circuit and constants.



The crystal set assembled

The set was designed with the host of new amateurs in mind, so that a set simple to construct and still simpler to operate was the result. The factors of economy, simplicity of construction, and simplicity of operation lead to the choice of the single circuit crystal receiver, which is the most logical introduction to the ultimate vacuum tube receiver. The particular circuit chosen after some experimentation is shown in figure 1 in detail, which also gives the coil tapping. It will be observed that the circuit is a conductively coupled or auto-transformer circuit with fixed secondary having 85 turns. This particular type of single circuit tuner with the particular constants here specified was found to be easily 25 to 50 per cent. superior to the type of circuit shown in figure 2, and was found to give almost equal results on local reception with a loose coupled receiver. Of course, it should here be stated, it is not meant to imply that circuit in figure 1 is invariably superior to circuit in figure 2. What is meant is that with the constants properly chosen for circuit 1, circuit 1 is then superior to circuit 2.

The main tuning coil of this set consists of fibre tube, 3 inches O. D., 1/16-inch wall and 2¼ inches long, wound with 85 turns of No. 28 enamel covered wire. The coil is tapped at 10 points as shown in figure 1, namely at the 10th, 15th, 18th, 21st, 25th, 30th, 35th, 40th, 45th and 55th turns. It was found that for the average antennas 360 meters was tuned between the 15th and 35th or 40th turn, and that closest tuning was required between the 15th and 25th. The tapping was therefore chosen as indicated, and was found quite satisfactory for fair tuning. Tapping was continued to the 55th turn to take in stations having very small antennas, and to cover the range through about 450 meters. Best results and maximum audibility was obtained with a secondary having 85 turns, which was the deciding factor in winding the coil to this extent. It is quite probable that the distributed capacity of the coil plus the associated capacities of connecting wires, telephone cords, etc., give the entire coil a natural period in the neighborhood of 360 or 400 meters, which may account for the very excellent reception obtained with this particular set of constants. It will be observed that at no setting, therefore, is there enough coil to absorb any of the energy of the incoming wave, thus reducing absorption and dead-end losses to an absolute minimum. Increased efficiency is the inevitable result of using just enough coil to cover your wave length requirements, and it is suggested to set builders that too much and unnecessary wire means large losses and low efficiency.

The crystal detector employed is a real sensitive galena crystal which was found to give about best results. A pair of 2,000-ohm Mesco phones was used. In dotted lines around the phones will be found the conventional telephone condenser of 0.002 micro-

farad capacity. This condenser is connected in dotted lines for the reason that the writer found that it was not essential, but those who build a set like it may prefer to use it. The reason the writer did not find it necessary is that the capacity of the telephones and telephone cords was probably sufficient to by-pass any radio frequency which might flow that way. However, a telephone condenser was used originally, though no better results were obtained with than without it. If a telephone condenser is used the standard paraffined paper condenser as sold by the General Apparatus Co. or Mesco or any of the radio dealers, having a capacity of between 0.001 and 0.002 micro-farad, is satisfactory.

The panel of the set is a black fibre panel, 4½ inches square; ⅛-inch thickness was originally used, but was found to buckle and warp so much that 3/16-inch was finally decided on. This thickness will be found to be quite satisfactory. The drilling layout of the panel is illustrated in full detail in figure 3. It will be observed that with the exception of five holes, all holes are drilled (No. 28 drill) for 6-32 screws, thus making the drilling of this panel a very simple matter, since practically all holes can be drilled with one setting of the drill. Two No. 56 drill holes were provided in case it was decided to use a nameplate of one sort or another, these holes holding the pins for the nameplate. A and G, and TEL are the holes for the antenna, ground, and telephone binding posts, respectively. The telephone posts were spaced 2 3/16 inches apart, as seen in the drilling layout for a special reason. The telephone condensers originally used have their eyelet holes spaced that distance apart, and by drilling the panel in this way a special mounting was saved, for the telephone condenser could then be simply slipped onto the binding post screws, at the same time the eyelets would make contact with the screws and thus avoid two special contacts. This labor saving device will be found quite useful. Figure 4 shows this construction.

The two No. 32 drill holes are for the two stop pins, which can be seen in the photograph of the set. These stop pins are of standard make, which can be picked up in any radio store for 2 cents apiece. These stop pins serve a double function in this set. They serve as stop pins in the first place, and secondly they are used to mount the coil to the panel. The method whereby this is accomplished is illustrated in figure 5. Two No. 32 drill clearance holes are drilled in the fibre tube, one on each end, separated by the same distance the stop pin holes are separated on the panel. The stop pins are then set in the panel and are extended through the holes in the fibre tube. Between the tube and the panel there is slipped over the stop pins a small piece of narrow fibre tubing (paper tubing will do, about 3/16-inch diameter), which act as spacers or bushings. Two lock nuts are then screwed on to the stop pins inside the coil tube as shown in figure 5. The fibre or paper spacers keep the tube rigid, thus supplying a firm mounting of the coil. The construction is extremely simple as seen from the illustration in figure 5. This is done on each end of the coil. The length of the fibre spacer is optional and should be made to allow for a very small clearance between coil top and panel and should be accommodated to the length of the stop pins obtainable.

The four binding posts used for antenna, ground and telephones are standard posts as seen from the photograph, as are also the 10 contact studs, all of which can be bought at any radio dealer's. The switch lever used in this set is a 0.010-inch prosphor bronze lever, having 1-inch radius for which the drilling has been made. This also can be purchased in a radio store. The switch knob suitable for this lever is optional with the builder and depends upon his taste largely. The knob used by the writer is the General Insulate Co.'s No. 930-A knob, which is just about the right size for this set and is of excellent appearance. The crystal detector for the set can be purchased entire, crystal cup, ball and socket and cat-whisker if desired and mounted right on the panel. The writer purchased the ball and socket, but built his own crystal cup, as illustrated in figure 6. The No. 52 drill hole in the crystal cup (see panel layout) is for a pin driven through the panel to prevent the cup from turning. This cup makes a very neat job as can be seen from the photograph. Dimensions and drilling data are given in this figure to enable its construction. Brass stock is used, which was then nickel plated. Four No. 6 R. H. wood screws tie the panel to the receiving cabinet as shown in the photograph. All the metal parts on the panel are nickel plated.

The receiver is mounted in a small cabinet made of birch wood, which was given a dark mahogany varnish. The cabinet is made of ¼-inch stock, and is 5 inches by 5 inches by 4½ inches deep. It has four corner posts glued in, which posts are recessed or dropped 3/16-inch from the top, so that the panel sets into the box, and the top of the panel is flush with the top of the box, as in the photograph. The four wood screws holding the panel to the cabinet are screwed into the corner posts.

This set is a very neat little outfit as can be well seen from the attached photograph. More important is the fact that it is an extremely efficient receiver for broadcast reception and gives surprisingly fine results. On occasions it reaches out to some distance, when receiving conditions are very favorable. But these results are freakish and not constant. Any crystal receiver is apt to reach out several hundred miles, conditions being favorable. But this receiver gives constant excellent results on local broadcasting up to a radius between 35 and 50 miles, and will repay the novice who takes the little trouble required to build this set.

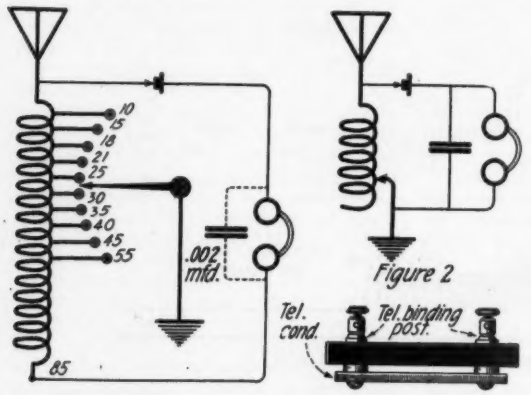


Figure 1

Figure 2

Figure 4

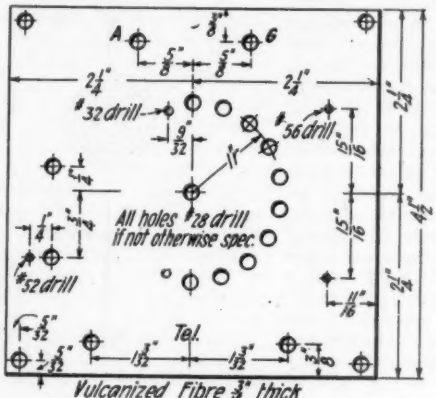


Figure 3

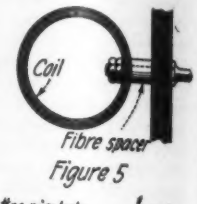


Figure 5

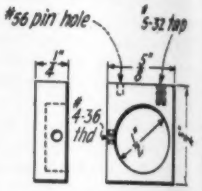


Figure 6

Constructional details and hook-up of the crystal set

Rectified A. C. for Amplifier Tubes

(*Continued from Page 70*)

The entire outfit, including rectifier tube with filament rheostat and tube socket, two condensers and choke coil were mounted on a panel of white pine wood, as shown in the layout sketch of figure 10. The two binding posts on the left are the input posts to which are connected the A. C. terminals from transformer or lighting socket supplying the A. C. to be rectified. The two binding posts on the right are the output posts from which the rectified voltage is led to the amplifier tubes.

The construction of one of these rectifying and filtering outfits will be found to be worth while to the experimenter. The cost is really very low. A tube socket and filament rheostat are generally to be found in every experimenter's station. For rectifier tube one of his amplifiers may be used. The cost of constructing the choke coil and the cost of the two condensers are then the chief items which can be picked up today, as prices run, for not over $5.00 to $7.00. The cost of a real good "B" battery up to 45 volts is around $5.00, and the small extra cost involved in the building of the balance is really soon paid for by results and saving of battery renewals.

Methods of Using Wavemeters, With Suggestions for Insuring Accuracy

By Bernard Steinmetz

THE main elements of the wavemeter are, as is well known, an inductance coil and variable condenser, which combination has been calibrated in wave lengths. In conjunction with these elements there is generally employed an indicating device for showing when the condition of resonance has been obtained with the circuit under measurement. Inasmuch as the wavemeter is used essentially for measurement purposes it is evident that the accuracy of measurements depends upon methods of using the wavemeter and may be impaired unless certain precautions are observed. There are a number of ways of using a wavemeter, some being more accurate than others, each having its own advantages and disadvantages.

The type of resonance indicator used on the wavemeter depends upon what kind of measurement is being made. Of course for extremely fine measurement work very sensitive indicators are used, such as thermocouplers, etc. However, these cannot be used for practical work around stations. In practical work there are two types of resonance indicators, one used for detecting currents of fairly large magnitude, and the other for detecting currents of small magnitude. The first type is used largely in transmitter measurements and may be either a glow lamp in series with the wavemeter coil, or a hot-wire milli-ammeter, as shown in figure 1. For best work the milli-ammeter should be used as the resonance point can be most accurately determined this way. If either of these indicators is used it is best to have the wavemeter calibrated with the indicating instrument, as otherwise errors are bound to creep in, due to the inductance and capacity of connecting leads and instrument. Also if the indicating instrument has appreciable resistance unless this is taken into account when the wavemeter is calibrated there will be considerable error due to the decrement of the wavemeter.

The second type of resonance indicator used in practice is for very small currents of the same order of magnitude as the received current in an antenna. In this case the most sensitive type of indicator to use is the combination of a crystal detector in conjunction with telephone receivers. Most measurements with wavemeters are made with this indicator, and the accuracy of the measurement will depend upon the manner of connecting the indicator. There are a number of ways of connecting the detector and telephones which will be considered here.

The reason the addition of detector and telephones affects the accuracy of the wavemeter readings is that its capacity and resistance affects the wave length and decrement of the wavemeter. Some methods of connection produce a negligible effect while others produce a large effect. The main methods of connecting the detector and phones are shown in figures 2 to 7 inclusive.

The circuit shown in figure 2 is the one usually used, and is the one which is the least accurate unless the proper precautions are taken. The connection shown in figure 2 introduces very large capacity, relatively, due to the leads from the detector and phones. Obviously unless this capacity has been taken into account the errors resulting will be large. The greater the wave length the less the error will be and vice versa. This circuit increases the decrement of the wavemeter very much which results in broad tuning, thereby introducing another factor increasing inaccuracy. The sensitivity of this type of connection is very good, however, and it is

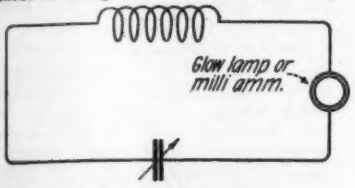


Figure 1

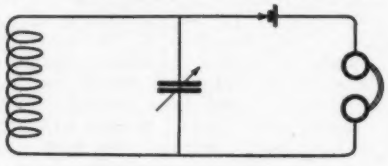
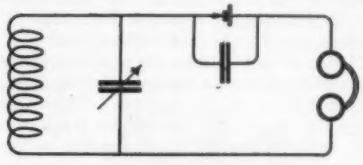


Figure 2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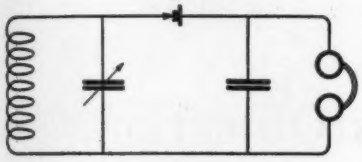


Figure 4

Figure 5

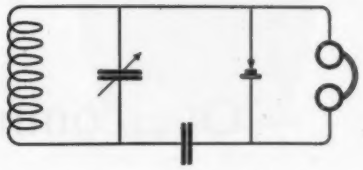


Figure 6

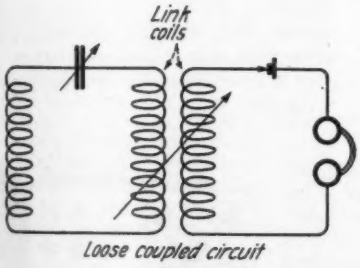


Figure 7

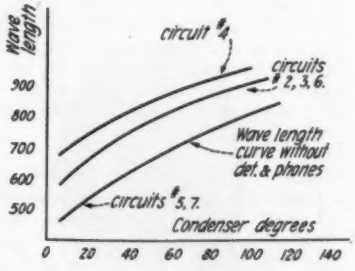


Figure 8

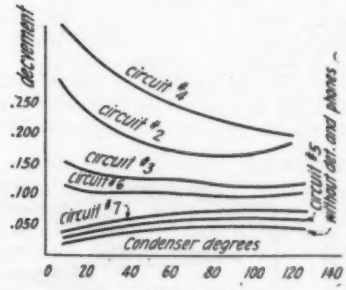


Figure 9

Graphs and various wavemeter circuits

Table of Audibilities

Circuit No.	Relative Audibility
2	55
3	85
4	45
5	10
6	40
7	15

for this reason that it is used so generally.

The circuits shown in figures 3, 4 and 6 act, with slight modifications as the circuit of figure 2. Circuit 3, however, is the most sensitive of all the circuits, and circuit 4 is the least accurate.

Circuit 5 is the so-called unilateral connection. This connection gives the most accurate results of all, but at the same time is the least sensitive. The addition of the detector and phones does not alter the calibration of the wavemeter and hence will not affect the accuracy of results. The action of this connection is that the loop circuit consisting of detector and phones is coupled to that of the wavemeter and hence is actuated by electromagnetic induction. However, it is obvious that the coupling is very loose and hence the sensitivity must be very low. Where high sensitivity is not required, but where accuracy is above all essential, the unilateral connection of figure 5 should be used.

Circuit 6 is the case where the detector and phones are, in a separate circuit, loosely coupled to the wavemeter. Thus this scheme is adapted to cases where large currents are present and loose coupling in the detector circuit is employed to prevent excess current flowing in it. This circuit is similar to circuit 5 in that it is extremely accurate and the presence of the detector circuit has practically little effect on the calibration of the wavemeter. It also is very insensitive for loose coupling, although somewhat more sensitive than the unilateral connection.

The great advantage of circuits 5 and 7 is that they do not increase the decrement of the wavemeter circuit, and hence permit of sharp tuning which is always essential in wavemeter measurements.

Comparative figures on these various types of wavemeter connections are given by the Bureau of Standards and the tabulated figures show the relative sensitivities of these schemes in audibilities. From this table it is seen that the circuit of figure 3 is the most sensitive, while the generally used circuit of figure 2 is next sensitive. Least sensitive are the unilateral and loose coupled schemes of connection.

Figure 8 shows graphically how the various circuits affect the wave length calibration. The calibration of the wavemeter without any resonance indicator attached is shown by curve 1. It is seen at once that the unilateral and loose coupled connections of figures 5 and 7 produce no change in wave length and hence are most accurate. The scheme of connection shown in figure 4 produces the greatest change in wave length and hence is the least accurate. The other circuits produce also fairly large changes in reading and should therefore be compensated for in some way, preferably by calibrating the wavemeter with detector and phones attached.

Figure 9 shows the effect of the various schemes of connection on the decrement of the wavemeter. It is seen that the unilateral and loose coupled circuits of figures 5 and 7 produce hardly any change in the decrement of the wavemeter and hence will produce the sharpest tuning which is advantageous for wavemeter work. Circuit 4 produces the greatest increase in the decrement of the wavemeter giving the broadest tuning, hence it will be the least accurate which is verified by the curves of figure 8. Circuit 2 which is the most commonly used circuit is seen to produce very large decrement increases at the low waves.

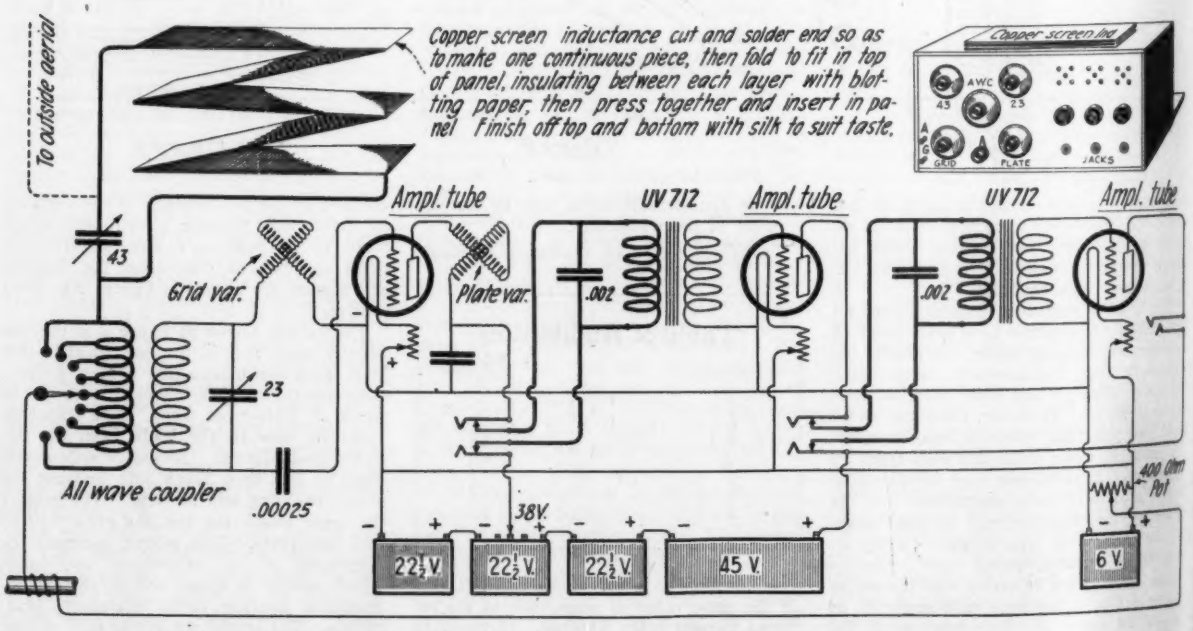
From these curves and data it is seen that the least sensitive of the connection schemes are the most accurate and result in sharpest tuning. Whereas the ones that are more sensitive are less accurate and produce large decrements with consequent broad tuning. If calibrations are made with detecting circuit in place the inaccuracies may be compensated, but the decrements and broad tuning will still persist. Where sharp tuning is essential, therefore, circuits 5 and 7 should be more frequently used.

Overcoming the Landlord's Objection

By Fred Jantzen

LIKE so many amateurs in this fascinating game of experimenting with radio I discovered a way to overcome the landlord's objection to erecting an aerial on the roof. It is just another case where observation and that old adage, "necessity is the mother of invention," has played its part.

I observed a roll of copper screening in a hardware store while waiting my turn; I intended to purchase material for constructing a loop aerial, but while waiting I was thinking of how I could use the screening and could not see why it should not work, so I changed my mind and purchased a square yard, the rest is as you see it explained in the drawing. There are many reasons why an indoor aerial constructed along these lines should prove very satisfactory in its efficiency for receiving, even over a distance.



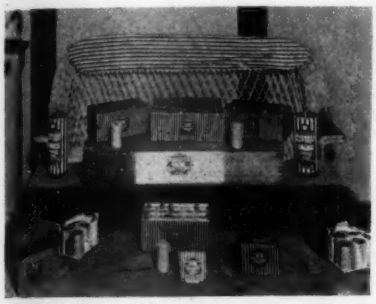
The vacuum tube receiver hooked up to the copper screen antenna that fools the landlord

NEW APPLIANCES AND DEVICES

Burgess Explains B Battery Construction

DURING the recent radio show in New York City the Burgess B battery exhibit attracted much interest from the visitors, as it explained in detail the construction of the B battery. The vast majority of radio users simply know the B battery as a heavy block from which protrude various terminals marked at different voltages. What is inside they do not know.

The Burgess exhibit furnished the information by showing a sample battery progressively cut away so that each part was shown in a manner to indicate its function. The battery, a 22½-volt unit, open at the side, showed the individual cells, 15 of them, connected in series, the wrappings of moisture-proof paper, the moisture-proof "egg crate" separator used to keep the cells apart, and the wax seal which not only covers the top of the assembly, but also is poured into the separator around the cells, going clear to the bottom, so that with the use of a reinforcing in the seal on the top, the battery is a solid block. Seamless drawn tubing of pure zinc is used for the individual cells, and a sample of this also was shown.



The Burgess exhibit

180-Degree Variocoupler

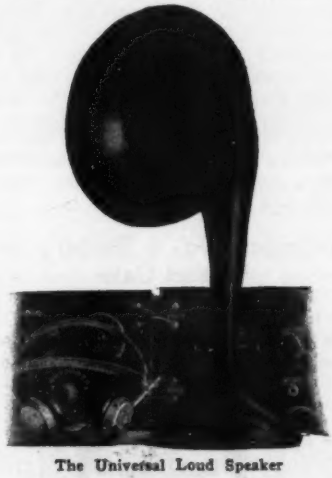
A NEW 180-degree variocoupler of sturdy construction has been added to the New York Coil line of radio apparatus.

The New York Coil variocoupler

The new device uses a bakelite tube for the primary, which is wound of double silk covered wire. For mounting a heavy steel angle member support is used. The secondary also uses a moulded bakelite tube, and the same character of winding used in the primary. It is carried on a ¼-inch solid shaft, supported by the steel angle member on which the primary tube is held. This construction assures permanent alignment. Flexible pigtail connections are used in order to assure a solid contact. The shaft forms no part of the circuit. The metal parts are heavily nickel plated throughout. The ratio of primary and secondary winding is such that the variocoupler may be used in any type of circuit. Substantial loops are provided for units and tens taps. The range in wave length is from 200 to 600 meters on the average antenna.

Universal Loud Speaker

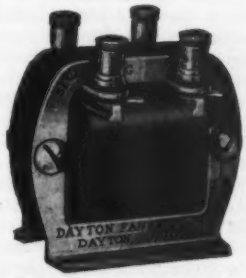
SO many radio fans have had such success with more or less extemporized combinations of headsets and horns in order to make a loud speaker that the Roller-Smith Co., New York City, has decided to offer a loud speaker built on that plan, but with the phones integral, the whole a well-proportioned unit. The "Universal" loud speaker, as it is called, represents the application of the Roller-Smith headset to a horn. Inside its base are two carefully selected receiver units, permanently fastened in place in such a position that the sound waves from each merge into a single tone chamber. The principles of acoustics have been observed in the design, and the position of the units with respect to each other and to the tone chamber is the result of much experimentation. The horn stands 21 inches high, has a 10½-inch bell and a 7½-inch base. Bell and horn are of cast aluminum, in a beautiful crystalline enamel finish.



The Universal Loud Speaker

Transformer for WD-11

THE large number of broadcast listeners who appreciate the qualities of the WD-11 tube, which uses a 1½-volt dry cell to heat the filament, and have decided to use it in amplifying units will no doubt be glad to learn of a new Day-Fan audio frequency transformer designed especially for this tube. The transformer is the result of extensive laboratory and practical tests that were undertaken to ascertain the exact transformer characteristics that would give best results with the tube in question. The manufacturer states that the result is a device that produces better results, both as regards amplification and tone quality, than the other Day-Fan transformers that have earned a large use among those who use the 6-volt Radiotrons.



Transformer for WD-11 tubes

Red Seal Radio Sparkers

THE new Red Seal Radio Sparker, made by the Manhattan Electrical Supply Company, is a dry battery especially designed for operating the new type dry battery vacuum tubes.

This new type of battery is light in weight and easy to handle. It is dry and clean with no injurious acid to spill. It will not scratch or mar the finest table top.

Read Seal Radio Sparker dry battery

They require no care or servicing—a great advantage to those living on farms or points distant from battery charging stations.

The cost per hour of service rendered by

a Red Seal Radio Sparker is much less than the cost per hour of service rendered by a storage battery, taking into consideration initial and recharging costs.

The individual cells in Radio Sparkers are connected in parallel, they are carefully selected, and the actual operating life of the cells is therefore increased from 2⅓ to 2½ times the operating life of a single dry cell.

The Red Seal Radio Sparker is made in the following sizes: No. 221-R, 2-cell, initial voltage 1½. Designed for operating a single WD-11, or similar dry battery vacuum tube; No. 262-R, 6-cell, initial voltage 1½. Designed for operating from one to three WD-11, or similar dry battery vacuum tubes; No. 282-R, 8-cell, initial voltage 1½. Designed for operating from one to four WD-11, or similar dry battery vacuum tubes.

Red Seal Winner

LOUIS PEINE, Houston, Tex., has been announced as the winner of the Red Seal Battery Contest for the general public. The contest required competitors to finish the sentence: "The Red Seal Dry Battery is best (1) because it is the all purpose battery and (2) because——." Mr. Peine won with "thirty years of experience are back of its seal." Second prize went to Ralph E. Turner, Medford, Mass., for: "it retains Nature's Energy under Seal;" and third prize to W. E. Long, Sterling, Ill., for: "Red Seal outside means more energy inside." Honorable mention went to fifty-one other contestants in all parts of the country. The contest for the best decorated dealer's window was won by the Louis D. Rubin Electrical Co., Charleston, S. C.; second prize, Geo. A. Myers & Co., Paterson, N. J.; third prize, Busch Hardware Co., Chicago, and H. L. Miller Co., Pasadena, Cal. The contest for the best letters written by jobbers' salesmen was won by W. J. Teefey, Kansas City, Mo.; second prize, Chas. A. Byers, Parsons, Kan.; third prize, Harry H. Goldstein, Hartford, Conn.

Fiber Horn

THE Fiber Products Co., Newark, N. J., have placed a line of fiber horns on the market for which many advantages are claimed.

Their horns are molded by hand and are

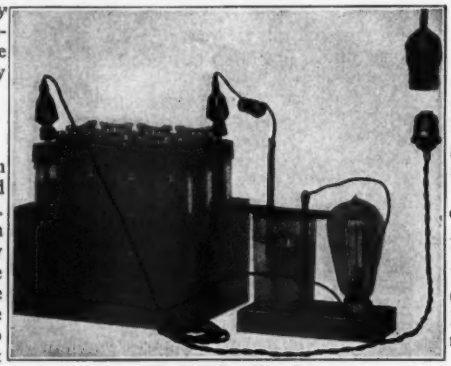
The Fiber Horn

all in one piece. Due to their method of construction and the materials used they are practically indestructible and reproduce music and speech with fidelity.

They are attractively finished in black crystalline, which adds materially to the appearance of any set and fits well into the finest surroundings.

Charging B Batteries

CHARGING a 22½-volt unit from the 110-volt house circuit is easily accomplished by use of the Mueller rectifier set, a device which recommends itself by its simplicity and cheapness. The set consists of a wooden base bearing an incandescent lamp socket, flexible leads with a screw plug at one end and battery clips at the other, a lead rod and one of aluminum, a wooden cleat with holes for these rods, and a package of borax. The user only has to supply a 25-watt electric lamp, an ordinary tumbler full of clean water, and the electricity.



Mueller Rectifier Set

The lamp is screwed into the socket, the borax emptied into the glass of water, the rods inserted in the cleat, the wire from the aluminum rod clipped to the positive pole of the B battery, and the other clip attached to the negative pole, the plug screwed into a lamp socket and the switch turned.

In this circuit the lamp, borax rectifier and battery are in series. A "B" battery of 30 volts or less is charged at the rate of from 1/10 to ¼ ampere, depending on the line voltage and the size of lamp. The outfit may also be used for charging from direct current, but in that case the rectifier jar is filled with salt water in order to determine the polarity, after which the water is thrown out and the rods short-circuited with a piece of wire. The lamp then operates as a rheostat.

Columbia No. 6 Battery with Steel Case

THE National Carbon Company, Inc., has announced that the Columbia hot-shot battery, the No. 1461—a four cell-power, 6-volt battery—which up to the pres-

Columbia No. 6 battery

ent time has been sold in a fiber container, is now being put on the market in a new steel container. This new battery is a great improvement over the old type which it replaces. Its price is to be the same to both the trade and user as the old fiber case battery. The other standard types of Columbia hot-shot batteries are to be put into steel containers in the near future.

Tells Antenna Facts

THE Milliken Brothers Mfg. Co., Woolworth Building, New York, has issued an impressive catalog devoted to radio antennas and towers.

The catalog is in reality a comprehensive treatise on the proper type of aerial and towers for use under various conditions. It is profusely illustrated with half-tones and line drawings showing the towers that the company has constructed for different important interests, as well as detailed drawings of towers for various spans of aerial in cold and warm climates. Engineering data and tables are given.

The Milliken name has been identified with the structural steel and iron business since 1857, and enjoys an enviable reputation in the trade. The company is a pioneer in the construction of galvanized steel wireless towers, and maintains an extensive engineering department for these towers and its other specialties.

Among the many Milliken towers erected may be mentioned those for New York Telephone Co., International Western Electric Co., United Fruit Co, Western Electric Co., as well as for the Governments of the United States, Great Britain, Cuba, New Zealand, Venezuela, and numerous others.

The book is brought out both in English and Spanish editions.

Denver Trade Organizes

RADIO jobbers in and around Denver recently organized the Radio Jobbers Association of the Rocky Mountain District, and already have, through co-operation, brought about better conditions in that territory. Initial members of the association are Hendrie & Bolthoff Supply Co., Mine & Smelter's Supply Co., Reynolds Radio Co., Inc., Rocky Mountain Radio Co., and the Winner Radio Co. Jack L. Hursch, general manager of the Reynolds company, is president and chairman; Baxter Lanius, of the Rocky Mountain company, vice-president and vice-chairman; Orvil Sibbald, secretary; and Mr. Vreeland, of the Winner company, treasurer.

Shortly following the organization of the association the name was changed to The Radio Service Bureau, and co-operation was secured from many newspapers in publishing articles over the Bureau's name, for the information of amateurs. The Bureau also has been active in co-operative advertising campaigns, and in devising plans for the movement of stocks that, while presenting serious problems to individual members, were easily taken care of by the Bureau as a whole.

Besides its work with the general public, the Bureau conducted a course of instruction for radio dealers and their salesmen in Denver, giving both sales and technical advice to a number of men who were more or less new to the radio business. In the Denver territory sales have to be made, in many cases, through demonstrations conducted in the prospect's home, which may be fifty or one hundred miles from the dealer's shop. The necessity for salesmen to be expertly qualified to meet emergencies is evident, more so than it is in those more thickly settled sections where a dealer can expect most of his prospects will walk into the shop and be satisfied with a demonstration on the set permanently erected there.

The Monthly Service Bulletin of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

Guglielmo Marconi, *President* | J. Andrew White, *Acting President* | H. L. Welker, *Secretary*

Founded to promote the best interest of radio communication among wireless amateurs in America

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HEADQUARTERS: 326 BROADWAY, NEW YORK

THE police in Baltimore, Md., last January asked a newspaperman to ferret out an expert radio amateur who would agree to listen to radio broadcasting stations operated by the police of other cities, and transmit all reports and warnings to headquarters. Publication of the police appeal in the Baltimore papers resulted in a flood of offers from amateurs, and the police are now well provided with immediate reports on matter transmitted by other police departments. The amateurs copy all police broadcasting and turn it in to the nearest Baltimore police station, whence it is transmitted over the wires to headquarters, and to all other local station houses. Already the co-operation of the Baltimore amateurs has proved so valuable in keeping the police informed of the activities of authorities in other cities that it is thought that the Baltimore police department itself may go into radio more or less extensively.

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A RADIO division of the Hudson River Yacht Club, New York City, which was formed just a year ago by eight yachtsmen who were interested in radio, now has thirty-one members and a station of its own, the call being 2CMG. This is one of the most substantial clubs in the metropolitan district, the members being all business men between the ages of 25 and 50, and practically every one the possessor of a motor boat or a yacht. A minimum age limit of 21 has been set in order to insure that the membership may be conservative. Five of the members have installed radio sets on their craft, and most of the others will do so this Spring, as soon as they can secure licenses. For this reason the code classes on Wednesday and Thursday evenings and the regular meetings on Monday evenings are being attended by practically 100 per cent. of the membership.

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MEMBERS of the faculty of the Central High School, Philadelphia, Pa., have formed a special group for the study of the radio telephone. About twenty-five professors meet every Wednesday in the school laboratory under the direction of Professor Lloyd N. Knoll, head of the Physics Department. The school has an enviable reputation for work in physics, Professor Elihu Thompson having experimented with the principles of wireless about fourteen years before Hertz announced his discovery. Its laboratories today are noted for their interesting equipment of historic and modern radio apparatus.

Recent Work of 6XAD

THE experimental station of Major Lawrence Mott, Avalon, Catalina Island, Calif., 6XAD, has been busy during the past month or so of good radio weather and has made an enviable record for consistency in long-distance short-wave work.

Major Mott states that in all this long-distance work, often with stations on the Atlantic seaboard, he has used no amplification whatever in receiving, all work having been done on only one tube, a soft detector tube.

Major Lawrence Mott of Avalon, the Radio Wonderland

In one case, when the signals of 6XAD were reported by John Haley, Wallington. N. J., Mr. Haley stated that his receiving antenna was flat on the snow, having been blown down by the wind during the course of a heavy snowstorm.

The list of stations which have been worked by 6XAD during January in two-way communication, is as follows:

1CMK	5XAJ	8JJ	8BKJ
2EL	7ZU	8YN	9CCM
2FP	7OM	8CYA	9DKQ
2AYU	7ZS	8ER	9BLY
2HJ	8VY	8MDG	9DUG
3ARO	8AJX	8CAA	9AAP
3CAN	8CGX	8ADG	9QF
3YO	8BVR	8BO	9AL
4EB	8ALC	8BEO	9DLF
5TJ	8LT	8DV	9OX
5AAB	8BDV	8NB	9KP
5IQ	8BXX	8BY	

As has been mentioned before in these columns, there's something about the personality of the operator of 6XAD, something about the climate, or something about the location of the island "where the flowers bloom all the year 'round" that has a mighty good influence on radio signals, both comin' and goin'.

THE Caldwell High School Radio Club, Caldwell, N. J., opened the new year with fifteen members, and every one is active in radio affairs. The club's receiving set is now in perfect condition and a 5-watt C. W. transmitter is under way. The installation of this is being delayed, however, due to the difficulty of erecting a good counterpoise ground without which the members of the club are very reluctant to go ahead.

△ △

R. H. G. MATHEWS of Chicago has been heard on the air with a claim to gold-plated wires in his outfit. He says the gold plating reduces skin resistance and prevents corrosion, but what the other 19,999 amateurs want to know is what happened to his pocketbook's resistance and how corroded his bank account got in the process. Brass keys are still in style—and what's the use of mere gold plating when we have solid platinum for buzzer contacts?

△ △

THE first meeting of the new year of the Milwaukee (Wis.) Amateurs' Radio Club was devoted to reports of the results of the 1922 trans-Atlantic tests of the A. R. R. L. The signals of one member, Marian Szukalski, Jr., 9AAP, were reported heard in Manchester, England. Attorney L. J. Topolinski, the club's recently appointed general counsel, reported the progress of the case of McWilliams vs. Bergman, in which an Illinois amateur is being sued on grounds of interference by a broadcast listener.

R. E. Lathrop, 9ATX, of the technical committee, read a paper entitled "Elimination of Distortion in Receptors" at a recent meeting, and at a later one gave an informal talk on the topic of electric wave traps. Under the leadership of E. T. Howell, Sc.M., technical committee chairman, several discussions have been had in which much light was thrown on the subject of filters for C. W. transmitters.

Through the efforts of Charles S. Polacheck, a former secretary-treasurer, but now a resident of San Francisco, Business Manager L. S. Baird was able to present a report on the activities of the well-known San Francisco Radio Club. Axel G. Berg, Chicago sales representative of the Radio Corporation of America, addressed the society on the attitude of large radio corporations toward amateurs.

At the suggestion of the committee on relays and interference, the club will again enforce the ruling of no testing at 7.00 p. m. All Milwaukee amateurs are asked to adhere to this rule.

MEMBERS of the Hudson Radio Club at New York City who have not yet changed over to C. W. have been hard at work at it since hearing a lecture by C. G. Kilbourne, who recently gave a talk on Continuous Wave Telegraphy. His demonstration of the superior economy and surprising range of C. W. was an eye-opener to some of the spark operators.

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THE library of the Central High School, Philadelphia, usually contains more students than books, but on January 19 it had more radio sets than either. Members of the C. H. S. Radio Club exhibited their home-made apparatus, which crowded the tables. Instruments were shown in great variety from simple receivers that cost only a few dollars, to elaborate C. W. transmitters.

△ △

MARION, Ohio, has a radio club composed not only of local amateurs, but also of novices, broadcast listeners and, in fact, anybody who is interested in radio. The club has mapped out a broad scale platform for meetings in the Y. M. C. A., and superintending of educational features for the general public.

△ △

THE Atlanta Radio Club, Atlanta, Ga., is trying out a new idea in club activities, having separated its membership into two classes, senior and junior, with the seniors scheduled for some fatherly activities in the interests of the juniors. The seniors are composed exclusively of licensed operators, and everybody else is a junior. The experiment is being watched with interest by neighboring clubs, and much is expected of the new form of organization. The seniors think that they can do a great deal in the promotion of better radio through their new consolidated body, and so far the juniors have preserved a respectful listening attitude of co-operation.

△ △

J. CARELTON HOLTBY, 3BIF, Philadelphia, Pa., has clinched his presidency of the Landsdowne Radio Club by being heard on the Pacific Coast, having received a card from Richard B. Martindale, Los Angeles. Holtby uses a cage antenna 100 feet long between two 48-foot iron masts.

△ △

THE Twin City Radio Club, Minneapolis, Minn., claims to have the best meeting place of any radio club in the city, namely, the Mayor's reception room in the City Hall. Weekly meetings are held here. The club is devoting much attention to C. W., and at a recent meeting discussed the construction of a 5-watt transmitter at minimum cost, since which several of these instruments have been heard on the Twin City air.

△ △

BECAUSE there was no radio club within commuting distance of Waterford, New York, the amateurs and radio fans of that city have organized and now meet regularly in the American Legion rooms under the leadership of James A. Gavin. The call for the organization meeting was sent out by Wendall King, station 2ADD, by radio telephone.

Meetings of the Waterford club are held in the Town Hall, to which an antenna has been strung for a demonstration of receiving apparatus. Radio fans in Troy, Cohoes, and other cities are showing much interest in the club, which already has a membership of 50. The organization is unique in that no initiation fee is being charged at present, the plan being to let this detail go until it has been determined what radio apparatus the club will purchase, whereupon a method of financing this acquisition will be gone into. The only qualifications for membership are that the applicant must be at least 17 years of age and be interested in radio. Meetings are being held every Friday evening.

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THE Washington Radio Club, Washington, D. C., has elected its officers for 1923, placing D. G. Lyons, of the White & Boyer Company, operating station WJH, at its head. He is forming comprehensive plans for the balance of the year.

△ △

THE Indianapolis, Ind., branch of the American Institute of Electrical Engineers, gave over one of its recent meetings to radio broadcasting. The members gathered in the studio of WLK and listened to Francis Hamilton of that station describe the principles and operation of a broadcasting transmitter. After the lecture they inspected the apparatus in detail.

△ △

THE radio clubs of the Central, Western Business and Eastern High Schools, Washington, D. C., have joined hands with the Washington High School Radio Association and are considering ways and means of installing a transmitter in the new Eastern High School building. Thornton P. Dewhirst, of the Central, was elected chairman of the new association; Stanley Glasser, Central, is traffic manager; Russell King, business secretary and treasurer.

△ △

ONE radio association that has been going about its business very quietly but successfully is the Polytechnic Radio Association, Baltimore, Md. Point was given to its success when the treasurer presented the financial statement of the association for the first half of its fiscal year, showing a very healthy condition as a result of co-operation between the members and the officers. The association does not get into the public eye very much, but certainly appeals greatly to its membership. A recent meeting heard Eugene B. Link, honorary president, deliver a lecture on the history of radio. Mr. Link described the progress of the art from the earliest times, and illustrated his talk with apparatus, some of it of historic character. One of the old Marconi coherers was put in operation and used to pick up signals sent out by the 1 K. W. transmitter in the Polytechnic electrical laboratory, giving most of the members of the club their first opportunity of hearing this historic bit of apparatus in actual operation.

△ △

THE second annual amateur radio show in Cleveland, Ohio, held during January, drew a crowd of about 5,000 Clevelanders daily. Hundreds of radio sets constructed by Cleveland amateurs, were on view, and prizes totaling $800 were awarded their constructors. The show was held in the display room adjoining the lobby of Keith's Palace theater.

THE city of Chicago is still undecided about its proposed radio ordinance, which would provide for inspection and licensing of all receiving sets as well as all transmitting equipment. There has been a considerable struggle over the ordinance, the City Department of Gas and Electricity being in support of it, and practically everyone else against it.

△ △

THE Radio Club of Hartford, Hartford, Conn., on January 24 opened its monthly meeting to broadcast listeners, with the idea of educating them both in operation of broadcast receiving stations and as to the relation that the amateur bears to radio as a whole. The meeting was well attended by an assortment of new radio fans of all ages, who listened with great interest to an explanation and demonstration of a 3-circuit receiving set. When it came time to present the case of the transmitting amateur a surprise was sprung in the form of a mock trial in which a broadcast listener prosecuted an amateur for interfering with the concerts. It was hard to say who laughed the most, the amateurs or the novices, and the trial served a very valuable purpose in placing the position of the amateur before the novice in a forceful, yet amusing, way.

△ △

UNITED States Civil Service Examinations are listed below. Applications for these examinations may be had from the local secretary of the Civil Service Board at your post office, or, if not available there, may be secured from the U. S. Civil Service Commission, Washington, D. C. The examinations are held simultaneously on the dates given in several cities in each state, applicants presenting themselves at the nearest examining office.

Radio Inspector. Vacancies in the Bureau of Navigation, Department of Commerce, at from $1,800 to $2,200 a year, plus bonus. Examination to be held March 7. Duties will consist of examination of ship and shore radio stations. Candidates will be examined in theoretical and practical questions in the construction, use and adjustment of radio apparatus, and will have to show proof of their education and experience in the line of these duties. Applicants must be wireless telegraph operators, and have the degree of bachelor of science from a school of recognized standing or be senior students in such a school; or must have the equivalent of a high school education and at least two years' experience in special radio work such as the manufacture, adjustment or use of commercial or government radio apparatus.

Junior Radio Engineer. Examination, March 7. As there has been considerable difficulty in securing sufficient eligibles for this position, qualified persons are urged to enter this examination. Vacancies exist throughout the United States, at from $1,800 to $2,400 a year, and also higher and lower salaried positions will be filled from this examination as warranted by qualifications of appointees. Examination will include general physics, mathematics through calculus, practical questions on radio engineering, and education, training and experience. Applicants must show that they have been graduated with a degree from a college of rec-

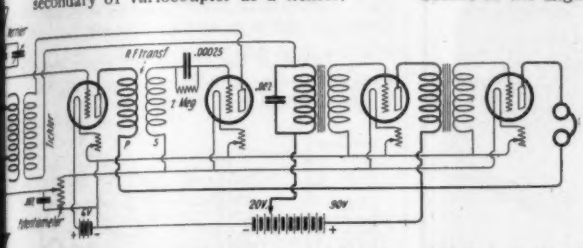
(*Continued on Page* 85)

QUERIES ANSWERED

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed. Positively no questions answered by mail.

Dr. H. J. Savage, Corning, Ohio.

Q. 1. Please give me a hook-up for one and two stages radio frequency using a single circuit tuner, 43-plate condenser and variocoupler in a real circuit, using the secondary of variocoupler as a tickler.

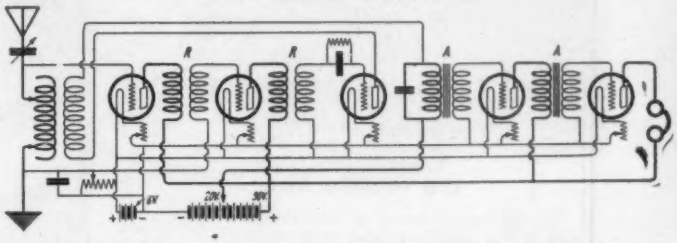


A. 1. Above are the hoop-ups you ask for. Note that it is desirable, with R. F. amplification, to use a two-circuit tuner instead of a single circuit turner in order to obtain a high degree of selectivity. For additional information, look up the last six or eight issues of THE WIRELESS AGE, all of which contain a great deal of practical data on R. F. amplifiers.

Q. 2. Please advise me where I can secure information regarding application for license in the Eighth District.

A. 2. Apply for a license in Eighth District at Custom House, Detroit, Michigan.

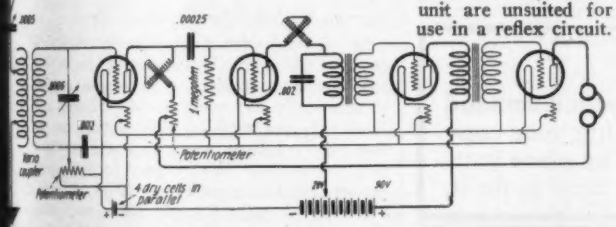
Q. 3. I am advised that I can make a wavemeter by winding 25 feet of No. 22 D. C. C. on a tube and connecting the ends of this coil to a 23-plate variable condenser and crystal using the hook-up below, and that this set will be calibrated for 200 meters by the Department of Commerce. Is this true? If true, should the whole thing be mounted in a box on a panel?



A. 3. The Radio Inspector of the Department of Commerce in your district will calibrate your wavemeter gratis. It does not matter very much how the apparatus is mounted, just so long as everything is secure and rigid.

E. P. Ackley, Brunswick, Me.

Q. Can you give me complete data of 4-tube set with one stage R. F. impedance coupled by means of two variometers and two stages A. F. using WD-11 tubes? I have seen the hook-up, but no data was given. Is an aerial condenser and potentiometer necessary with this set? Is an extra resistance besides the variometer necessary in the plate circuit?



A. Above is hook-up asked for.

You have probably seen similar hook-ups in previous issues of THE WIRELESS AGE, and we would recommend that you refer to these back numbers in order to obtain additional information. An extra resistance in the plate circuit is not absolutely necessary, but it is handy to have in the circuit. The potentiometer across the filament battery is necessary.

* * *

David S. Ross, Roxbury, Mass.

Q. In the January, 1923, issue of THE WIRELESS AGE, on page 60, figure 2, is a reflex unit, employing three tubes. I wonder if you can advise me as to the requirements of the variocoupler used in these circuits; the make, if possible, or number of turns and size of wire. Am desirous of building one of these sets and would like to start out right on the variocoupler end of it.

A. The variocoupler used should contain winding of the order of fifty or sixty turns on each winding. The number need not be exact. Almost any convenient size wire is suitable, from No. 18 to about No. 30 silk, cotton or enamel covered wire.

A. Eisenhauer, Jr., Newark, N. J.

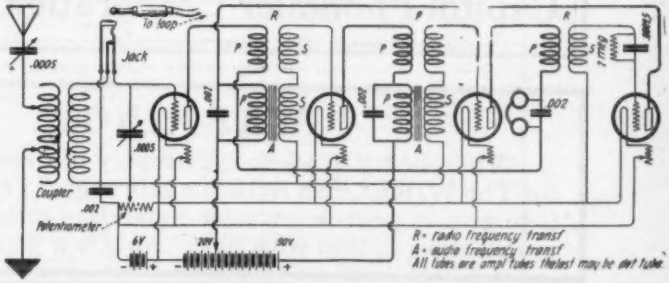
Q. Kindly furnish me with a reflex hook-up, having 3 stages of radio and 2 stages of audio-frequency amplification and a detector tube; using a 1/10-henry choke coil and a 12,000-ohm resistance unit, and with a jack for each stage.

A. The 1/10-choke and the 12,000-ohm unit are unsuited for use in a reflex circuit. Below is hook-up you request. Note that a jack is used for connecting the loop.

R = radio-frequency transformers.

A = audio-frequency transformers.

All tubes are amplifier tubes, although the last tube may be a detector tube.



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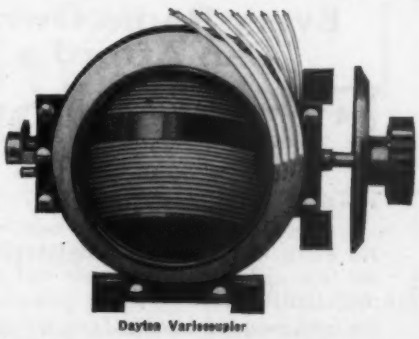
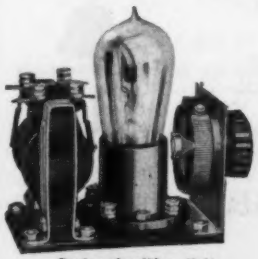


Dayton Variocoupler



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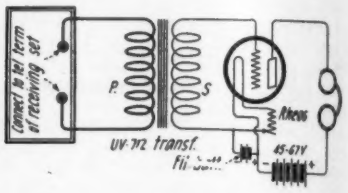
Dr. R. W. Gregg, Iowa City, Iowa.

Q. I have a Clapp-Eastham type H. R. single circuit regenerative receiver with detector only. As I wish to build a one-step audio-frequency amplifier for this outfit, please give me diagram of circuit and directions for assembling the amplifier. Also please tell me if radio-frequency amplification would be practical with my set. If so, are the so-called "peanut" tubes as good for this purpose as UV-200 or C-300? Is there any way of making my set finer tuning? Would a three-plate variable condenser to act as a vernier help any?

A. Below is the circuit for a one-stage audio-frequency amplifier, to go with the Clapp-Eastham type H. R. receiver.



Radio frequency amplification may be employed with your set. For information on this matter, see answer to Dr. H. J. Savage in these columns. "Peanut" tubes, such as the WD-11, or the new radiotron UV-199 are entirely satisfactory. A 3-plate vernier condenser would undoubtedly help in giving finer tuning. Fading is a phenomenon the cause of which has not as yet been determined.

* * *

Raymond West, Northampton, Mass.

Q. I read with some interest an article on page 68 of the January issue, regarding loud speaker circuits. I have a set which is practically the same as Mr. Fitch's and I wish to use rectified high voltage on the last tube. I have everything except those two condensers. With regard to those condensers, is the capacity as given, 8 mfd., right? I thought I might make one using photographic glass 5 inches by 7 inches as the dielectric, and foil as the conductor, but do not know how many sheets are required. I am sending you a sketch of the wiring of my set, leaving out jacks for simplicity. Will you kindly advise me if I have properly connected the high voltage? Also, do I need the small condenser, near the R. F. choke coil as shown in your diagram? What size?

A. The capacity of 8 mfd. is correct. As a matter of fact, even better smoothing would be obtained with a larger condenser. We would advise against making a condenser of this capacity with glass plates, as it would require several thousands of them to get the above value. Use eight 1 mfd. condensers in parallel. These condensers should be able to stand the high voltage and we can recommend the Radio Corporation's model UV-1632 filter condensers. The latter are guaranteed for 750 volts and should prove satisfactory. Do not try ordinary paper telephone condensers as they are designed to withstand a breakdown voltage of only 100 volts. Your high voltage is properly connected. The small condenser near the R. F. choke coil as shown in the diagram of the January issue should be included in the circuit.

Fred Ortmann, Cambridge, Mass.

Q. I would like to know the relative efficiency of the following devices for charging from one to five 6V 80 A. H. batteries.

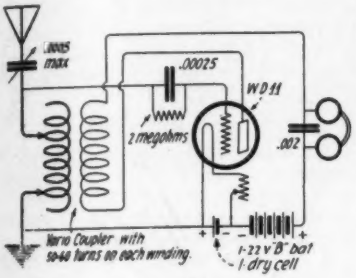
A. For charging a single storage battery, the vibrator and vacuum bulb are the most efficient. Where a number of batteries are to be charged, it is best to use either the mercury arc or motor-generator. We would recommend the motor-generator in the latter case because of its greater convenience.

* * *

Robert C. Smith, Garden City, Mo.

Q. I would like to know the best hook-up for a radio receiving set using a WD-11 bulb.

A. Below is hook-up for a WD-11 bulb.



* * *

F. D. Parker, Cohutta, Ga.

Q. I have a radio frequency amplifier made of Radio Corporation parts and according to their published diagram, two stages using separate antennas for tuning. I did good work on it and it works fine on NAA's wave of 2,650 meters with straps disconnected, but with straps connected as for short waves and on 360 and 400 meter waves I can't tell that it amplifies at all. Can you suggest what might be the trouble? All wiring is as short and direct as I could get it.

A. There are several causes for trouble in a radio frequency amplifier of several stages:

1. The input inductance must be of a proper value. Try changing the size of the coil which is connected to the grid and filament of the first amplifier tube.

2. There may be coupling between the windings of the transformers of different stages. Try turning the transformers with respect to each other, and try shielding them by placing sheets of copper or brass between them. Move the transformers to different positions—neglect the matter of length of leads.

3. Try interchanging tubes—try different tubes—varying the filament rheostats and potentiometer.

4. Try disconnecting straps across secondaries—leaving straps on primaries connected.

* * *

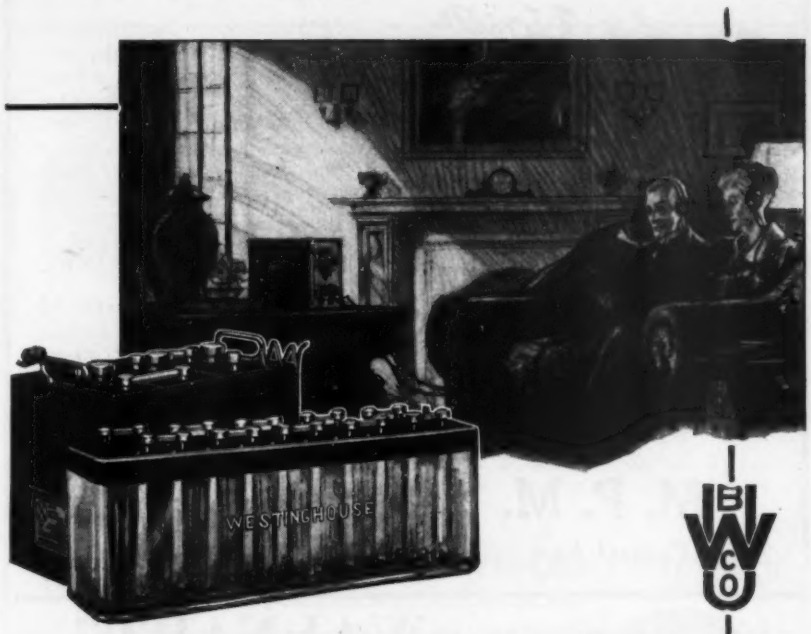
L. B. Hallman, Jr., Dothan, Ala.

Q. How does the author of "The Wireless Experimenters' Manual" get 0.0044 mfd. for the following?

$$C=\left(\frac{2}{15^2}\right)\left(\frac{500}{1000}\right)=.0044 \text{ mfd.}$$

A. The author, E. E. Bucher, is correct in his calculations:

$$C=\left(\frac{2}{15^2}\right)\left(\frac{500}{1000}\right)=\frac{1000}{225\times 1000}=\frac{1}{225}=.0044$$



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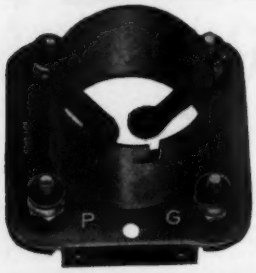

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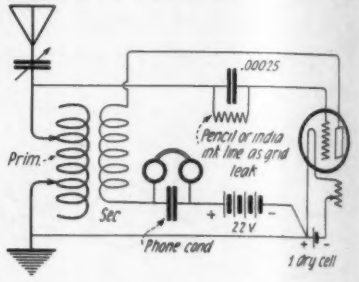
Peter R. Copping, New Orleans, La.

Q. 1. Enclosed you will find hook-up of a crystal detector set which I am now using. Please change same to a vacuum tube circuit using one WD-11 or "peanut" tube as a detector. I was told that a good grid leak for tube mentioned above can be made by drawing various lines on a piece of cardboard in India or draftsman's ink. Is that so?

A. 1. Below is hook-up for regenerative receiver using WD-11 tube. Yes. A better scheme is to draw pencil lines with a medium pencil between the two terminals until



the loudest response is obtained. If too many lines are drawn, erase some of them.

Q. 2. When shielding a set, does it make the signals weaker?

A. 2. Shielding does not make signals weaker. It merely prevents your body from detuning the set.

Q. 3. Will the hook-up given be regenerative?

A. 3. Yes.

Q. 4. What would the resistance and approximate wavelength be of an aerial consisting of three No. 14 wires 75 ft. long, 23 ft. high, spaced 1¼ ft. apart?

A. 4. The fundamental wavelength would be approximately 230 meters and the radio frequency resistance at 360 meters about 20 ohms.

* * *

P. A. Hardaway, Pawtucket, R. I.

Q. I notice that in all the R. C. A. receiving circuits for amateurs the rheostat is shown on the plus side of filament with lead of secondary connected to the minus leg. As I understand it, the minus B-battery connected to the minus filament gives a plate voltage of the B-battery itself; while if connected to the plus filament plate voltage will be that of the B-battery plus the voltage in use in the A-battery—hence the A-battery potentiometer to give a regulation of the B-battery voltage and as much as might be required of the A-battery voltage to get a critical adjustment. This means that to get the benefit of this voltage in the plate circuit plus, one must work potentiometer towards the A-battery connection, which throws the plate circuit in the filament through the resistance of the rheostat. If such is the case why wouldn't it be good practice to place secondary lead onto the plus filament and place rheostat in minus filament and thus dodge its resistance? Are there any reasons why a receiver should not work better, when connected this way?

A. There are a number of grave flaws in your recommendations. In the first place, the resistance of the filament rheostats, although perhaps an ohm or so, is extremely small compared with the resistance or impedance of the tube and the transformers and phones, which is of the order of 20,000

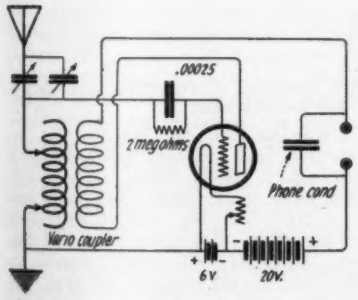
ohms. In the second place it is poor policy to connect the secondary winding of the transformer to the positive side of the A-battery, for then the grid would become positive and a stream of electrons would flow to the grid. This shunt path would just about kill all the amplification in the tube. There is, however, no objection to placing the rheostat in the negative filament lead—and then connecting the secondary of the transformer to the negative end of the battery. Since the tube takes a drop of 5 volts, and the storage battery is 6 volts, we have a drop of 1 volt in the rheostat, and the grid of the amplifier tube is one volt negative with respect to the negative end of the filament. This state of affairs is highly desirable, since it causes less plate current to flow and is thus economical of B-battery. For a detector tube, it is best to connect to the positive side of the filament. We believe that you would be interested in studying the behavior of vacuum tubes and can therefore recommend an excellent textbook, E. E. Bucher's "Vacuum Tubes in Wireless Telegraphy." You will find many of your questions answered after a thorough study of its contents.

* * *

Charles Vaccaro, Washington, D. C.

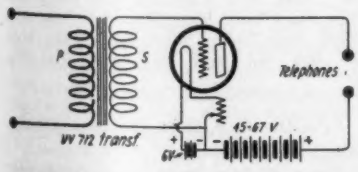
Q. 1. Will you kindly publish a good hook-up for a set containing 43 plate variable condenser, vario-coupler, variometer, radiotron UV-200 tube, grid leak and grid condenser, and phone condenser? I would like to cover great distance.

A. 1. Below is hook-up of receiver. The vario-coupler should have about 50 or 60 turns on each winding.



Q. 2. Also publish hook-up for one-step amplifier to go with same. Please do not publish amplifier connected with above set.

A. 2. Here is hook-up for amplifier:



Q. 3. About how far can I hear without amplifier? With amplifier? My antenna is about 150 feet long (four wires), and thirty-eight feet above the ground.

A. 3. You will be able to hear about 200 or 300 miles without amplifier and probably up to 1,500 miles with the amplifier, under good receiving conditions.

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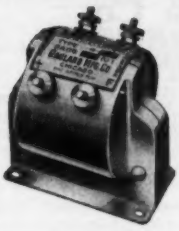

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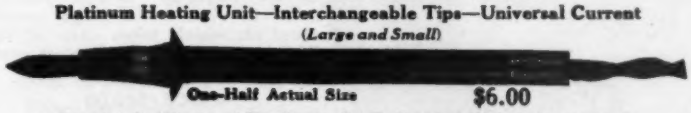

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Frank H. Dargue, Kittanning, Pa.

Q. Within the next few months I expect to install an amateur ten-watt C. W. transmitter and I will have to build a new receiving set that will get the amateur stations with great clearness and still be selective. The present set I now have is suited for phone reception but not for 200-meter work. I am enclosing two circuits and will ask that you advise me which set would be best to use on amateur C. W. and spark reception.

A. Both of the circuits that you show will work well for 200-meter reception. Which is the better is chiefly a matter of individual opinion, although many amateurs prefer the variometer type of circuit.

STATIONS WORKED AND HEARD

Stations worked should be enclosed in brackets. All monthly lists of distant stations worked and heard which are received by the 10th of each month will be published in the next month's issue. For example, lists received by November 10th will be published in the December issue. Spark and C. W. stations should be arranged in separate groups.

JOSEPH F. TYNAN, 3128 Corlear Ave., Kingsbridge, N. Y. City.

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* * *

6CU, CHARLES F. FILSTEAD, 2010 6th Ave., Los Angeles, Calif.

CW.—1xx, 5hk, 5ir, 5px, 5qy, 5tj, 5xd, 5za, 5zak, 5zav, 5zh, 5zy, (6abx), 6ada, 6adf, 6ajr, (6ak), (6akl), 6amz, (6anh), (6aoi), 6aor, 6arb, 6asj, (6asx), 6atq, 6aub, 6auu, 6awt, 6bbh, 6bcr, 6bju, (6bjy), 6bmd, 6bnu, (6bnv), 6bnw, 6boe, 6bow, 6bqf, 6bql, 6bsa, 6cb, (6cc), 6dd, (6fh), (6gx), 6gy, 6ii, 6iv, 6km, 6ku, 6lo, 6lv, 6nx, 6ok, 6rk, 6rm, (6tc), 6ti, 6tw, 6vm, 6xb fone, 6zac, 6zb, (6zh), 6zi, 6zo, 6zt, 6zx, 6zz, (7aem), 7aiy, (7bb), 7bj, 7bk, 7fd, 7fr, (7hj), 7jw, (7lr), 7mf, 7na, 7ny, 7ot, 7qn, (7sc), 7sy, 7th, 7tq, 7ud, 7zo, 7zu, 8aqo, 8aqq, 8atc, 8cur, 8cyv, 8ju, 8qk, 8ue, 8vy, 8xj, 8zw, (8zy), 9ajp, 9amb, 9arz, 9aul, 9avz, (9awm), 9ayu, 9bey, 9bhd, 9bik, 9ji, (9bm), 9bpy, 9bsi, 9bzi, 9caa, 9ccv, 9cmk, 9cns, 9dfb, 9dky, 9dte, 9dtm, 9dxa, 9ei, 9gk, 9pi, 9xaq, 9yaj, 9yw, 9zaf, 9zn.

CANADIAN—4bv, 5cn, 9ac, 9al.

SPARK—6aoa, 6aqu, 6bak, 6kc, 6km, 6qr, 6tu.

These stations were heard on detector alone and worked on ten watts.

* * *

8AEB, R. I. BARRINGER, Kalamazoo, Mich.

1ax, 1aw, 1aws, 1bgf, 1bka, 1bas, 2el, 2kf, 2ql, 2wr, 2brb, 3bt, 3bp, 3zo, 3ajj, 3bej, 3bbl, 4el, 4ft, 4ka, 4kl, 4kz, 4vk, 4yo, 5ha, 5xv, 5ek, 5za, 5sk, 5sm, 5aam, 5ade, 6xad, 6aow, 6ka, 6en, 6ard, 7sc, 7lu, 7zo, 7zu, 7afw.

9ZT, D. C. WALLACE, 54 Penn Ave. N. Minneapolis, Minn. (January).

CW.—1fd, (1qp), 1xm, 1xu, 1asf, 1bas, 1bes, (1bka), (1bkq), 1boq (1ckp), (2fp), 2kf, (2xq), 2afb, 2agv, 2ajf, 2bmr, 3bv, 3fo, (3oe), 3ot, 3su, (3xm), 3vo, 3zo, (3ava), 3bij, 3bof, 4bi, 4cg, 4co, 4el, (4gg), 4gz, (4hw), 4kl, 4km, 4ya, (5be), 5cy, 5di, (5ee), (5ek), 5fv, 5gj, 5gr, 5jb, 5ml, 5nn, (5ns), 5nz, (5pd), (5px), 5qi, 5qm, 5rz, (5sf), 5sm, 5ta, 5tc, 5tj, (5uk), (5us), (5we), 5xa, (5xb), (5xt), 5xv, 5za, 5zb, (5aah), (5aam), 5ade, (5aec), 5aib, 5ant, (5xad), (5xaj), 5xav, (5zak), 5zat, 5zaw, (5zax), (5zaz), 6fh, 6jt, 6qn, (6zz), (6abx), 6anh, (6apw), 6boe, (6xad), (7lu), 7qm, (7sc), 7afw, (8aa), (8cf), (8cp), (8cy), (8ek), (8ij), 8jj), (8oi), (8rj), (8wx), (8yd), (8yu), (8adg), (8adt), (8aim), (8alc), (8apw), (8awp), (8azg), (8bdo), (8brd), (8bwa), (8ccb), (8ced), (8cgb), (8crb), (8ctn), (8cwp), (8dal).

CANADIAN—(3ad), (3co), 3de, 3ji, (3ta), (4hh), (9al), 9bx.

NAWA

(*Continued from Page 78*)

ognized standing, or furnish proof of graduation within three months of the examination; studies must have included electrical engineering. Special credit will be given for experience in a scientific, industrial or technical laboratory.

Radio Engineer. Applications will be rated as received until May 1, 1923. Vacancies exist at $4,000 to $5,000 per year. The duties are: to conduct or superintend the development, design, construction, installation, standardization, and the writing of specifications for practical and special apparatus and methods of radio communication, such apparatus to include sets for land use for more or less permanent stations, also for portable land stations, and for airplane and ship sets; to carry out advanced technical work in radio research; to analyze the data accruing from observations of the operation of various radio apparatus and installations; to make recommendations as to policy, apparatus, or installation in accordance with inspections; to plan and execute experimental investigations and to perform other related work. Competitors will not be required to report for examination at any place, but will be rated on their education and preliminary experience, special experience and fitness, publications, reports or theses. Applicants must have graduated from a college of recognized standing, and must show that they have had at least five years' experience (which may include postgraduate work) of a highly specialized or highly responsible administrative nature in radio engineering, such as employment as an executive in a radio factory, or in responsible or sole charge of radio design, or major lines of radio research, or in charge of the direction of the policies of a radio engineering organization.

Associate Radio Engineer. Applications will be rated as received until May 1, 1923. Vacancies at $3,000 to $4,000 a year. Competitors will not be required to report for an examination but will be rated on the same subjects given above for the position of Radio Engineer. They must show that they have had at least three years' experience or postgraduate work of a specialized investigative or responsible administrative nature in radio engineering.

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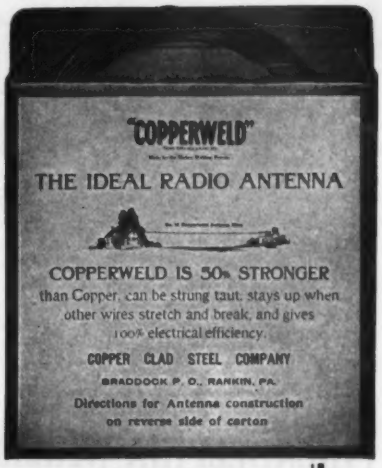
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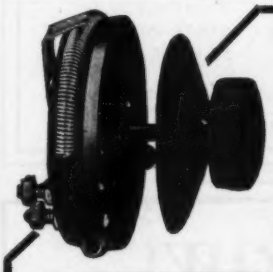

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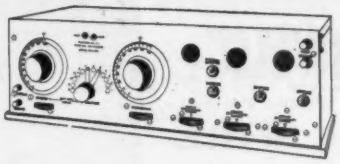

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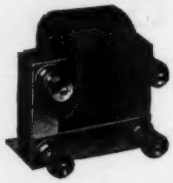

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△ △

OFFICERS of the Utica Radio Fraternity, Utica, N. Y., have been elected as follows:

President, Eugene Vaeth; vice president, L. F. Smith; secretary, Myron Allbright; treasurer, Lyle Regler.

Eliminating Interference from Commercial Power Lines

(*Continued from Page* 58)

Observations were again made of the induction and signal strengths over the same period and under identical circumstances as the previous tests with a result that the calculated ratio favored the signals by about 10 per cent. This was hardly an appreciable change and other tests were made in an attempt to solve this important problem, for with the induction driving in with the signals, the curves plotted from observations went askew.

It then occurred to me that I might be able to introduce some of the commercial frequency energy into some part of the receiving circuit so that the interfering induction might be neutralized by the compensating current through a 180-degree phase displacement. Accordingly a coil of six turns having a radius of two inches was inserted in the grid circuit. This was inductively coupled to a similar winding, the terminals of which were joined across the 110-volt line through .0005 condensers. By rotating the compensating coil with respect to the grid inductance, an adjustment was found which very appreciably reduced the induction.

While attempting to still further improve the signal-induction ratio I unconsciously passed the compensating winding over the detector tube and was surprised to note that when lowered over this tube a point of elevation was reached where the induction was absolutely eliminated. Immediately, a mechanical arrangement was devised for adjusting this coil, its plane horizontal, with respect to the detector tube elements. When completed, a Vernier control of the coil made it possible to maintain a perfect balance and thereby eliminate induction during all periods of the day and evening when ordinarily there would be wide variations in the strength of disturbance.

This device was found applicable in combating interference to reception on wavelengths from 200 to 20,000 meters and although identical circumstances may not prevail at all receiving stations, this scheme should be given a trial by experimenters who are troubled with interference from nearby power lines.

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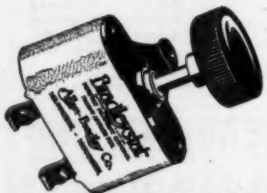

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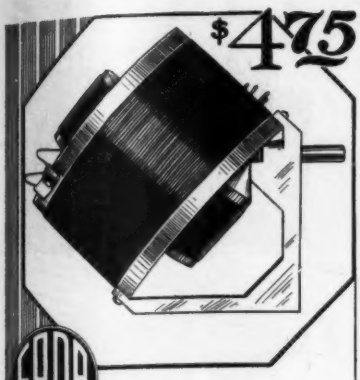

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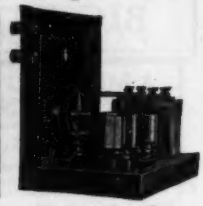

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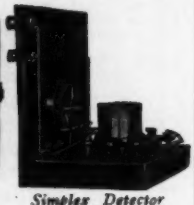

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Insure perfect reception. All you need is a tube of this paste solder and a match to heat it. Results guaranteed equal to bar solder.

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NEWARK NEW JERSEY

Coast Representatives:
Pacific States Electric Co., San Francisco, Los Angeles, Oakland, Seattle, Portland, Spokane.

Super-Sensitiveness!

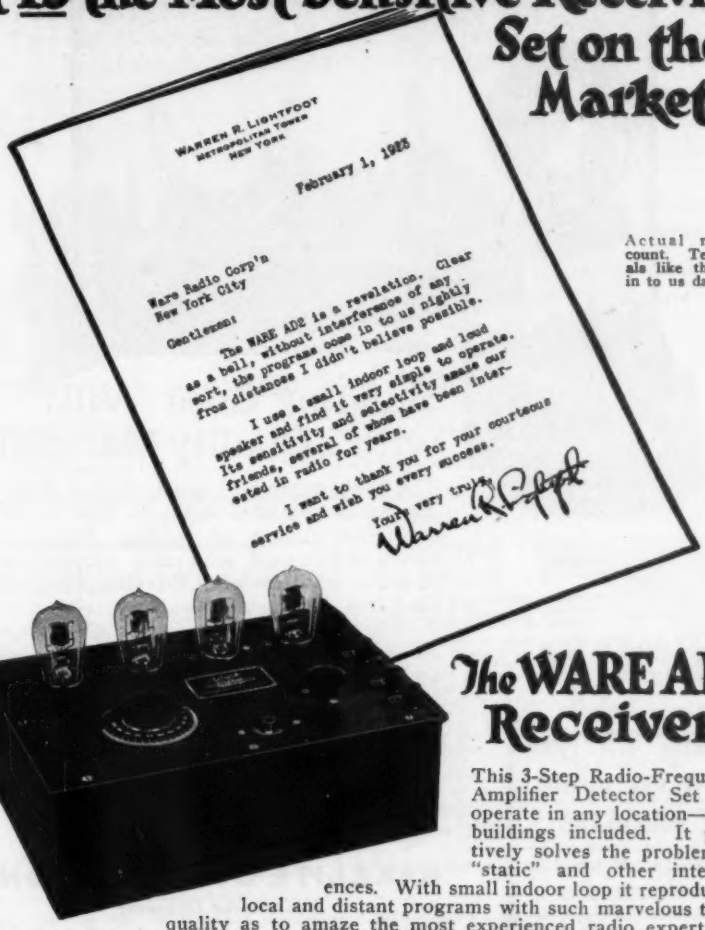
The crystal is the "bull's-eye" of your crystal receiving set. Unless it is super-sensitive you are wasting time and entertainment and cannot "hit" the combination for best results. Insist upon the genuine original Arlington tested "NAA" Detector minerals. They are carefully selected from bulk stock, individually tested and guaranteed super-sensitive. Galena, Goldite or Silicon, price for crystal, 25c. Same mounted in brass cup, 40c. Obtainable at your dealer's or sent direct (postpaid) on receipt of price.

Newman-Stern Building Cleveland, Ohio

The Newman-Stern Co

Ware

It IS the Most Sensitive Receiving Set on the Market



WARREN R. LIGHTFOOT
METROPOLITAN TOWER
NEW YORK

February 1, 1923

Ware Radio Corp'n
New York City

Gentlemen:

The WARE AD2 is a revelation. Clear as a bell, without interference of any sort, the programs come in to us nightly from distances I didn't believe possible.

I use a small indoor loop and loud speaker and find it very simple to operate. Its sensitivity and selectivity amaze our friends, several of whom have been interested in radio for years.

I want to thank you for your courteous service and wish you every success.

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Warren R. Lightfoot

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This 3-Step Radio-Frequency Amplifier Detector Set will operate in any location—steel buildings included. It positively solves the problem of "static" and other interferences. With small indoor loop it reproduces local and distant programs with such marvelous tone quality as to amaze the most experienced radio expert. It IS the most sensitive Receiving Set on the market and fully guaranteed.

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Ware

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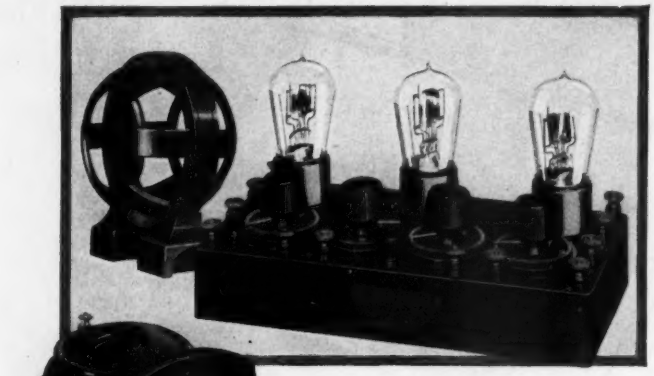

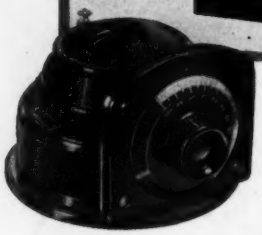

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BAKELITE CORPORATION
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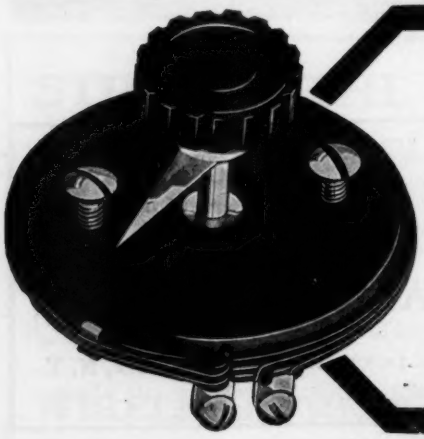

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New Developments, C.W. Transmission, Vacuum Tube Circuits, Regenerative Receivers, Underground and Loop Antennas, Radiotelephony, Relaying, Operating Department Work, all A.R.R.L. News, Humorous Stories by The Old Man. All these and many more are included in QST.
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Enjoyable concerts and maximum receiving range are obtained only when your battery is fully charged.

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charges your "A" or "B" battery over night for a nickel without removing it from your living room. No muss—no trouble—no dirt—requires no watching.

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2 sockets	2.00
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—Total amplification, 38.6

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It is doubtful if the substitution of any one thing in a radio set could make such a notable improvement as the installation of an AMERTRAN.

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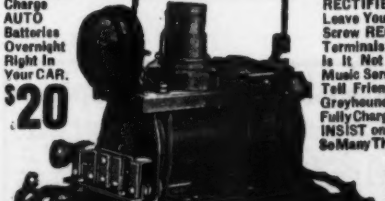
They Also Charge AUTO Batteries Overnight Right In Your CAR. **$20**



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And A 2 Foot Loop Aerial

(The MA-13)

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Fort Worth 1285 Miles
Havana 1567 Miles

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Honolulu 4278 Miles

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Havana 1680 Miles
Calgary 1667 Miles
Porto Rico 2036 Miles
San Diego 2070 Miles
Los Angeles 2070 Miles
San Francisco 2210 Miles

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Denver 1200 Miles
Salt Lake City 1530 Miles
Havana 1671 Miles
San Francisco 2180 Miles

From **CHICAGO**

Havana 1621 Miles
Los Angeles 1840 Miles
San Francisco 1955 Miles

The New Star in the Radio World

They copied all they could copy,
But they could not copy our mind;
We left them tearing and swearing
A thousand miles behind.
—Kipling.

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1. **Unequalled Sensitivity**—Exceeds the sensitivity of the average set many times. The above record demonstrates this.
2. **Fine Selectivity**—Permits differentiation of stations 1% off tune.
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The MU-RAD dealer in your town will gladly let you listen in on either type MU-RAD receiver

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Two Types MU-RAD SETS

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"Just Listen—The Omnigraph will do the teaching"

THE OMNIGRAPH Automatic Transmitter will teach you both the Wireless and Morse Code—right in your own home—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute. THE OMNIGRAPH is not an experiment. For more than 15 years it has been sold all over the world with a money back guarantee. The OMNIGRAPH is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses the OMNIGRAPH to test all applicants applying for a Radio license. The OMNIGRAPH has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models, $14 to $30. DO IT TODAY.

THE OMNIGRAPH MFG. CO.
16A Hudson St. New York City

If you own a Radio Phone set and don't know the Code—you are missing most of the fun

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Eliminate the Aerial and Obtain Better Reception with the NASSAU

LOOP TUNER
TRADE MARK

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Jobbers and Dealers write for Proposition

The Secret is in the Patented Winding
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With 2 stages radio and
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of the World

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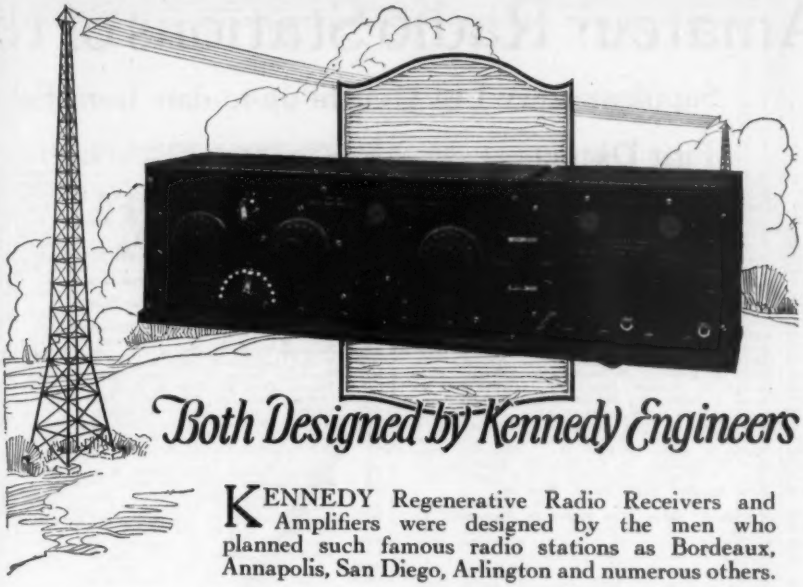

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They designed every element in the assembly—the inductances, variometer, vario-coupler, condensers, etc.—not only in accordance with the most advanced developments, but also to perfectly harmonize in operation. This feature of "balanced design" in Kennedy sets makes for closer tuning, absence of extraneous noises, and assures satisfactory reception.

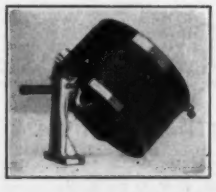
There are three types of Kennedy Receiving Sets. *First*, Type 281 (shown above) specially designed for broadcasting wave lengths. *Second*, the Intermediate, for wave lengths of 200 to 3,200 meters. *Third*, the Universal, an all-wave set.

Write for descriptive literature and prices.

THE COLIN B. KENNEDY COMPANY
SAN FRANCISCO SAINT LOUIS

KENNEDY

KENNEDY EQUIPMENT



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180° VARIO-COUPLER *and* VARIOMETER
All tubes are GENUINE BAKELITE, wound with green silk covered wire
Distributors, Jobbers and Dealers write for attractive prices

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Amateur Radio Stations of the United States

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1 HN Harold S. Johnson, 87 Oxford St....Hartford, Conn.
1 JV Leo R. Peloquin, 4 Palm St.....Worcester, Mass.
1 UQ Roland S. Brunesu, 15 Haviland St....Boston, Mass.
1 VD Charles E. Hale, Jr., 9 Beech St....Gardiner, Maine
1 AAY Kenneth M. Gold, 197 Beech St....Holyoke, Mass.
1 ABE Fred J. Walsh, 21 Perkins Ave....Hyde Park, Mass.
1 AMX Roxbury Latin School, Kearsarge Ave., Roxbury, Mass.
1 ANB Clyde T. Smith, 117 East St.....Windsor, Conn.
1 ACH Amedio V. Sgarzi, 292 Court St....Plymouth, Mass.
1 AOI George H. Herriott, Station 22.....Windsor, Conn.
1 AOM Ivan H. Small.....So. Harwich, Mass.
1 AOO Joseph G. Parent, 14 Congress St.....Lynn, Mass.
1 AOP Jack H. Johnson, 40 Vista Ave.....Medford, Mass.
1 AOU Ralph P. Day.....W. Millbury, Mass.
1 AOV Albert H. Waitt, 60 Vernon St.....Newton, Mass.
1 AOX Frank A. Bathrick, 39 Harvard St....Everett, Mass.
1 AOZ Andrew H. Wheeler, Depot St.....Poultney, Vt.
1 APC Robert J. Welch, Jr., Enfield St.....Enfield, Conn.
1 APF Deering High School, Stevens Ave....Portland, Me.
1 APG Hans R. Grafe, Fort Adams.....Newport, R. I.
1 APH Wilder A. Fernald, 37 C St.....Lowell, Mass.
1 APJ Walter B. Haase, 187 Fitch St.....Westville, Conn.
1 APM Geo. M. Woodman, Jr., 826 Main St..Westbrook, Me.
1 APN Albert G. Dias, 61 Woodbridge St.New London, Conn.
1 APQ West Hartford High School, Sims St., W. Hartford, Conn.
1 APU William F. Moore, 6 La France St..Springfield, Vt.
1 APV Charles J. Twist, 102 Prospect St....Norwich, Conn.
1 APZ William M. Stearns, 20 Centre St..Watertown, Mass.
1 AQC William J. Goodrich, 162 Jordan Lane, Wethersfield, Conn.
1 AQF Walter A. Rida, 810 Savin Ave....W. Haven, Conn.
1 AUI Elmer Gobalet, 27 Chatham St.....Worcester, Mass.
1 CIK St. Paul's School Radio Club.....Concord, N. H.

CHANGES IN ADDRESS

1 AMF Herbert C. Wirt, 23 Prescott St....Brookline, Mass.
1 BE Henry W. Wickes, 145 Somerset Ave.Winthrop, Mass.
1 BJS Francis J. Mulligan.....Damariscotta, Maine
1 BM Homer E. Nichols, 60 Benham Ave..Bridgeport, Conn.
1 BUB Fred A. Dame, Central St.....Kittery, Maine
1 CCP Arthur L. Durkee, 34 James St....Greenfield, Mass.
1 CJW Waldemar I. Bendz, 91 Atlantic Ave.Fitchburg, Mass.

Third District

3 DH Princeton University Radio Club...Princeton, N. J.
3 NI Alfred Cramer, 3rd, 211 Fifth St.....Camden, N. J.
3 NV John Rook, 210 W. North Ave....Waynesboro, Pa.
3 QY J. Sidney Williams, 3801 Moss Side Ave., Richmond, Va.
3 VC Francis Gresham, 428 Main St.....Salem, Va.
3 VO Horace H. Crow, 22 S. Boulevard St., Richmond, Va.
3 NX Elmer L. Langford, 1820 Oliver St...Baltimore, Md.
3 OE Oscar W. Lummis, 806 Kenmore Road, Philadelphia, Pa.
3 OO Berthold Carmosin, 1654 N. Marshall St., Philadelphia, Pa.
3 UV Leighton E. Causey, 1524 Moran Ave...Norfolk, Va.
3 AMV Addison Armstrong, Cedar Ave.....Clementon, N. J.
3 BBO Douglas H. Friedman, 1710 N. Franklin St., Philadelphia, Pa.
3 BBP Henry W. Driscoll, Jr., 2803 Hilldale Ave., Baltimore, Md.
3 BBT Robert B. Batte, 916 Raleigh Ave.....Norfolk, Va.
3 BBV Clair R. Grim, 1940 Bellevue St...Harrisburg, Pa.
3 BCE Frank P. Amsden, Jr., 107 Reily St.Harrisburg, Pa.
3 BCG Herman J. Jess, Box 132, R. F. D., No. 3, Annapolis, Md.
3 BCH Wilton H. Birdsong, 209 Grove Ave..Petersburg, Va.
3 BCI Lewis H. Pierce, Jr., 8528 Cuyera Ave., West Philadelphia, Pa.
3 BCL Frederick W. Donaldson, 2112 E. Susquehanna Ave., Philadelphia, Pa.
3 BCM George J. Cornelius, 6120 Jackson St., Philadelphia, Pa.
3 BCN Maurice W. Sloan, Jr., 5846 Woodbine Ave., Philadelphia, Pa.
3 BCR Frederic H. Williams, 101 S. Amherst St., Ventnor City, N. J.
3 BCT Louis Niemann, Jr., 2739 N. Fifth St., Philadelphia, Pa.
3 BCY Thomas D. Winters, 1125 Peach St., Philadelphia, Pa.
3 BDA Clarence F. Wicker, 225 E. Allen St., Philadelphia ,Pa.
3 BDB Frederick Barlow, 26 Perdiacaris Pl., Trenton, N. J.
3 BDH Arli Anderson, 921 Marlborough St., Philadelphia, Pa.
3 BDO Russell U. Waite, North West Ave., Vineland, N. J.
3 BDZ Samuel N. Howell, 401 Bullitt Ave., Roanoke, Va.
3 CEI Frederick L. Kahmer, 5226 Linden Heights Ave., Baltimore, Md.
3 AX Sarbacher, Irving R., 2644 N. Maryland Ave., Baltimore, Md.
3 BK Wilson, Rev. Arthur K., Main St., Bloomsburg, N. J.
3 CB Bigelow, Allen C., 833 West State St., Trenton, N. J.
3 CU Shanklin, John F., Jr.....Marion, N. J.
3 DN Rosenberg, Max, 434 South 52nd St., Phila., Pa.
3 DO Archer, John A., 3329 Auchentoroly Terrace, Baltimore, Md.
3 HC Werner, George L., Bethlehem Prep. School, Bethlehem, Pa.
3 HH Hallowell, H., Jr., 300 Summit Ave., Jenkintown, Pa.
3 FY Boy Scouts of America, Troop No. 9, P. Breeden, 105 Linden St.....Richmond, Va.
3 FZ McCutchan, Will R., 1818 "G" St., N.W., Washington, D. C.
3 EN Taylor, Russell R., 323½ North Penn St., Allentown, Pa.
3 GL Berry, George M., Baltimore & Allegh. Ave., Towson, Md.
3 HQ Browne, William M., 231 Ninth St., N. E., Washington, D. C.
3 HR Steele, Robert C., 2013 Wolfe St., Baltimore, Md.
3 ID Baxter, Frank C., 2603 Ismeninger St...Phila., Pa.
3 IE Moore, John E., 220 S. Church St...Waynesboro, Pa.
3 IO Glidemeyer, Fred H., 4824 Fairhill St..Phila., Pa.
3 JF Weed, Edgar M., 12 Phoenix St...Morristown, N. J.
3 KA Pittman, Charles A., Jr., 7421 Sprague St., Phila., Pa.
3 KG Miller, William H., 4608 Elrode Ave., Baltimore, Md.
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3 SW Moore, Arthur B., 703 Boissevain Ave., Norfolk, Va.
3 SZ Sandbridge, Henry E., Ashby Station....Bayard, Va.
3 ABH Wolf, Clarence, Jr., 1521 N. 16th St.....Phila., Pa.
3 ABP Crouse, Charles W., 13 Cleveland Ave., Waynesboro, Pa.
3 ACJ Peters, Raymond J., Chestnut St...Waynesboro, Pa.
3 ACT Buffington, Edward P., 1820 Boas St...Harrisburg, Pa.
3 ACZ Schmick, Arthur, 514 North Ninth St., Camden, N. J.
3 ADC Fellows, Clifford, 412 Haddon Ave.....Camden, N. J.
3 ADN The Penn Radio Club, 667 Preton St.....Phila., Pa.
3 AEF Weeden, Gregory, 235 Maple Ave., Takoma Park, Md.
3 AEW Holt, Walter L., 2925 North 6th St....Phila., Pa.
3 AFY Young, George G., 1222 Rush St.....Phila., Pa.
3 AHE Levin, Harry D., 402 N. Sycamore St., Petersburg, Va.
3 AII Wellen, Henry S., Main Street.....Fairton, N. J.
3 AIR Culbert, Denny C.....Marion, Va.
3 AKY Heisley, George E., 404 Shepherd St., Washington, D. C.
3 AOT Turner, Herbert G., 43 South Union St., Petersburg, Va.
3 APM Searing, Howard C., Main St.....Kenville, N. J.
3 ARE Huff, George W., 1430 Rhode Island Ave., N. W., Washington, D. C.
3 ARP Sheffer, Paul H., 41 S. Queen St.....York, Pa.
3 ARW Croll, Edward, 2742 N. 19th St.....Phila., Pa.
3 ASC Fink, William D., 27 Perdicaris Pl., Trenton, N. J.
3 ASF Braun, Albert H., 3226 N. 27th St....Phila., Pa.
3 ASG Chambers, Gordon H., 7430 Boyer St....Phila., Pa.
3 ASS Higgins, D. Nelson, Jr., Broad St., Virginia Apts., Portsmouth, Va.
3 ASV Barron, John H., Jr., 3022 Abell Ave...Baltimore, Md.
3 ATB Cooper, David L., 606 Sycamore St...Petersburg, Va.
3 ATC Welge, Charles J., 2332 S. Lambert St....Phila., Pa.
3 ATH Sweeney, Paul, 40 Lincoln St.....Hampton, Va.
3 ATS Dowell, Charles O., 323 E. Quarters..Fort Monroe, Va.
3 ATN Hforth, Arthur W., 2020 S. Croskey St...Phila., Pa.
3 ATT Miller, Frank C., 50 Delaware Ave..Morrisville, Pa.
3 ATU Keller, Kenneth W., 21 Pomona St., West, Phila., Pa.
3 ATV Thompson, Arthur T., 63A Lewis St., Phillipsburg, N. J.
3 ATX Terrett, William L., Jr., 2 New York Avenue, N. E., Washington, D. C.
3 AUA Nawa, Joseph C., 1341 Walnut St.....Reading, Pa.
3 AUC Clayton, Terah A., 626 Main St.....Danville, Va.
3 AUD Troy, Paul L., 2510 Jefferson St....Harrisburg, Pa.
3 AUG Dickey, Paul M., 1015 "K" St., N. W., Washington, D. C.
3 AUH Nowrey, Roland C., 921 Cooper St..Camden, N. J.
3 AUJ Cohn, Edward D., 3659 21st St.....Phila., Pa.
3 AUP Koeppen, Pauline B., Box 3, R. F. D. No. 5, Stuart, Va.
3 AUR Gittings, R. L., 67 Lincoln Road..Phillipsburg, N. J.
3 AUX Turner, Alfred H., 2105 Lancaster St.Wilmington, Del.
3 AUZ Pelletreau, William, 2537 S. Chadwick St...Phila., Pa.
3 AVI Entrekin, Leroy J., 1110 E. Lincoln St., Coatesville, Pa.
3 AVM Handwork, Walter H., 1044 Main St., Slatington, Pa.
3 AVN McGlathery, Richard, 5924 Pulaski Ave., Germantown, Pa.
3 AWL Price, Harold E., 242 West Second St., Waynesboro, Pa.
3 AWT Archey, Harry L., Jr., 215 Gowen Ave., Mt. Airy, Pa.
3 BAA Hallowell, Wilson, 2237 Coral St.....Phila., Pa.
3 BAD Brill, Harry, 300 West York St.....Phila., Pa.
3 BAE Voelmle, Herbert S., 1561 E. Montgomery St., Philadelphia, Pa.
3 BAI Smith, George, 2058 Dauphin St.....Phila., Pa.
3 BAK Binderwald, Eric L., 503 Highland Ave., Westville, N. J.
3 BAM King, Charles E., 3626 York Road....Baltimore, Md.
3 BAN Roll, John B., 9 Rockview Terrace, N. Plainfield, N. J.
3 BAQ Dreisbach, Clarence & Blair, 614 North 8th St., Philadelphia, Pa.
3 BAU Fifer, Philip F., 128 Lismore Ave....Glenside, Pa.
3 BAW Miller, Bernard V., 4818 Beaumont St..Phila., Pa.
3 BBC Nelbich, Charles M., 326 21st St.....Baltimore, Md.
3 BBI Pike, Merritt L., Crown Point and River Rd., Thorofare, N. J.
3 BOE Huss, Francis G., 835 Cheltenham Road..Phila., Pa.
3 BSP Haines, Edward H., 51 Browning St., Cumberland, Md.
3 CDN Heine, Lawrence J., 225 Broad St.....Bethlehem, Pa.

Fourth District

4 AY Monroe G. Ogden, 520 Orange St.....Macon, Ga.
4 BO Joseph M. Hart, Jr., 144 Cherokee Ave., Atlanta, Ga.
4 CV Albert L. Riddle, R. F. D. No. 4, Spartanburg, S. C.
4 DB Lee Womelsdorf, Jr., 103 Howard Heights, Cartersville, Ga.
4 DJ T. H. Nabors, 311 Willowbar Terrace, High Point, N. C.
4 DK Sherman Crise, 418 Lloyd St.....Greenville, S. C.
4 DO McIntosh M. Burns, 1736 Lee St.....Atlanta, Ga.
4 HE O. Frederic Olsen, 407 Cluster St.....Atlanta, Ga.
4 HN Daniel W. Smith, 130 S. W. North River Drive, Miami, Fla.
4 HU Thomas E. Blakely, 107 Carretera St., Santurce, Porto Rico
4 IA Lamar J. Landers, 164 Bonaventure Ave., Atlanta, Ga.
4 IE Fred A. Jewell, 149 Horner St....Henderson, N. C.
4 JG Rafael B. Carrero, 114 11th of August St., Mayagues, Porto Rico
4 KY Arturo C. Mescua, 10 Condado St., Santruse, Porto Rico
4 NF Smith, Raymond B., 68 Augusta Ave..Atlanta, Ga.
4 NG Fain, Albert L., 240 Wellington St....Atlanta, Ga.
4 NH Norris, Alonzo M., 35 Jackson St.....Newnan, Ga.
4 NI Woodall, Royce E.....Fairburn, Ga.
4 NJ Wetmore, Thomas B.....Arden, N. C.
4 NK Lang, John W., 704 E. Gadsden St., Pensacola, Fla.
4 NL Tesh, J. Fred, 223 White Oak St., High Point, N. C.
4 NM Robinson, Wesley, Jr.....St. Marys, Ga.
4 NN Griffin, James G.....Batonton, Ga.
4 NO Harvey Ditmore, Jr., 2022 Liberty St., Jacksonville, Fla.
4 NP Johnson, Chester B., 921 26th Ave.....Tampa, Fla.
4 NQ Boy Scouts of America, Macon Council, Perry, Ga.
4 NR Rivero, Manuel, 407 17th Ave.....Tampa, Fla.
4 NS Law, Fred B., 60 Penn St.....Atlanta, Ga.
4 NT Hinnant, Berry L., 211 W. Nash St....Wilson, N. C.
4 NU Potter, Harold D., 621 Pine St.....Orlando, Fla.
4 NV Day, Robert N., 232 Spring St., Winston-Salem, N. C.
4 NW Self, Freeman, 25 Brantley St.....Atlanta, Ga.
4 NX Zacharias, Eugene G., 133 Barnett St..Atlanta, Ga.
4 NY Arnold, Edw. B., 502 Gloucester St., Brunswick, Ga.
4 NZ Wilder, Robert O., 102 Fannin St....La Grange, Ga.
4 OA Lewis, James H., 188 St. Charles Ave., Atlanta, Ga.
4 OB Wall, Houstoun, 1407 Nance Ave.....Tampa, Fla.
4 OC Summers, Chas. H., Jr., 211 Poinsettia St., W. Palm Beach, Fla.
4 OD Taylor, Harry F., 186 Jackson St....Newnan, Ga.
4 OE Hoddorf, Christy J.....Winter Park, Fla.
4 OF Moore, Panchen, 54 Fairview Road.....Atlanta, Ga.
4 OG Ammons, Robert M., 39 Main St.....La Grange, Ga.
4 OH Todd, W. M., Jr., Apt. 14, 40 Cooper St., Atlanta, Ga.
4 OI Rexach, Luis, Box 319.....San Juan, Porto Rico
4 OJ Brown, Fred L.....Plant City, Fla.
4 OK Boy Scouts of America, Troop II, 143 Bull St., Savannah, Ga.
4 OL Wilder, Jas. M., 108 Fannin St.....LaGrange, Ga.
4 OM Phillips, F. H., Jr., 117 W. Bay St., Jacksonville, Fla.
4 ON Rogers, Warren O., Jr., 118 Langhorn St., Atlanta, Ga.
4 OO Henslee, J. B., 301 W. Taylor St.....Griffin, Ga.
4 OP Ward, Raymond O.....Winter Park, Fla.
4 OQ Strange, R. S., 145 Oak St.....Atlanta, Ga.
4 OR Ward, Harold A.....Winter Park, Fla.
4 OS Hannah, Joseph E., Jr., 34 Greenvide St., Newnan, Ga.
4 OT Rogers, Stanley H., 118 Langhorn St....Atlanta, Ga.
4 OU Ebaugh, Newton G., Alexander Apts., Winston-Salem, N. C.
4 OV Powell, Thomas, 130 Main St., Rocky Mount, N. C.
4 OW Cohen, Ralph W.....Beaufort, S. C.
4 OX Hill, Lawson E., 628 W. University Ave., Gainesville, Fla.
4 OY Buchanan, S. H., 369 King St....Charleston, S. C.
4 OZ Bailey, Cecil, 208 W. Seventh Ave.....Tampa, Fla.
4 AF Jenkins, Francis, 1246 W. Fourth St., Winston-Salem, N. C.
4 AK Arnold, Harry D., Bay Street.....Eustis, Fla.
4 AN Hill, Melvin T., 192 Windsor St.....Atlanta, Ga.
4 AO Hoffman, Jesse I., 447 Brevard St.....Arcadia, Fla.
4 AQ Pickett, Leon W., Orange Ave.....Sarasota, Fla.
4 AR James, Fred L., 211 Lee St.....Tampa, Fla.
4 AX Smith, Marvin C., 21 Walker Terrace....Atlanta, Ga.
4 BF McClung, L. W., 1601 S. 13th St., St. Petersburg, Fla.
4 BJ Rodriguez, Pedro, 50 Flores St., Catano, Porto Rico
4 BL Bryant, Lucius W. & Thomas E., 307 W. Hillcrest St., Lakeland, Fla.
4 BN Frick, Henry F., 1101 Swann Ave.....Tampa, Fla.
4 BV Simmons, Paul J., 804 E. Oak St.....Arcadia, Fla.
4 CH Crane, H. J., 3122 N. W. Second Ave., Miami, Fla.
4 CJ Graves, Q. L.....Homestead, Fla.
4 CM Jackson, Winston J., 49 Macon Ave..Asheville, N. C.
4 CR Connolly, Lewis A., 3100 10th St.....Tampa, Fla.
4 CS Abbey, Theo. H., 138 W. Baker St.....Atlanta, Ga.
4 CU Chapman, Richard C., 262 Juniper St...Atlanta, Ga.
4 CZ McSwain, G. H., 305 E. Magnolia St., Arcadia, Fla.
4 GP Jones, James F., 434 Dougherty St....Athens, Ga.
4 GV Morrison, Robert J.....Cherryville, N. C.
4 GW Kibbler, Ralph R., 59 Woodfin St., Asheville, N. C.
4 HG Williams, Scott, 914 Ball St.....Tampa, Fla.
4 HY DeSassure, R. L., 708 London St....Brunswick, Ga.
4 IY Davenport, F. S., Jr., 396 Grant St....Atlanta, Ga.
4 MM Griswold, Loren W., 184 Waller St., Jacksonville, Fla.

Ninth District

9 BDL D. L. Rice, 1321 So. 35th Ave.....Omaha, Nebr.
9 EHA Harry J. Palmer, 425½ S. Front St..Marinette, Wisc.
9 EHB William Barnes, R. F. D. No. 2, Sta. "B", Superior, Wisc.
9 EHC Ellery L. Plotts.....Hampton, Nebr.
9 EHD Louis E. Newman, 6100 Pershing St..St. Louis, Mo.
9 EHE Roger H. Gales, 910 College Ave...Davenport, Iowa
9 EHF Leroy R. Lesch.....Arden, N. C.
9 EHG Verne Goldin.....Mellette, S. Dak.
9 EHH A. J. Simandl and E. F. Preuss, 751 16th St., Milwaukee, Wisc.
9 EHI Charles F. Pippen, 403 E. Centennial St., Nappanee, Ind.
9 EHJ William P. Meyer.....Murdock, Nebr.
9 EHK Lyle R. Walker, 5650 Miami St.....Benson, Nebr.
9 EHL G. T. Bennett.....Rockford, Iowa
9 EHM Raymond T. Peschek, 1620 Walnut St., Milwaukee, Wisc.
9 EHN Eldon E. Roth, West 5th St.....Villisca, Iowa
9 EHO William L. Sharp, E. Main St.....Greenwood, Ind.
9 EHP Vernon A. Bloomquist, 510 Sherman St., South Bend, Ind.
9 EHQ John L. Donner.....Lena, Ill.
9 EHR Francis Melcher, 6609 Normal Blvd...Chicago, Ill.
9 EHS Lawrence F. Pfeller, 1810 N. 5th St., Sheboygan, Wisc.
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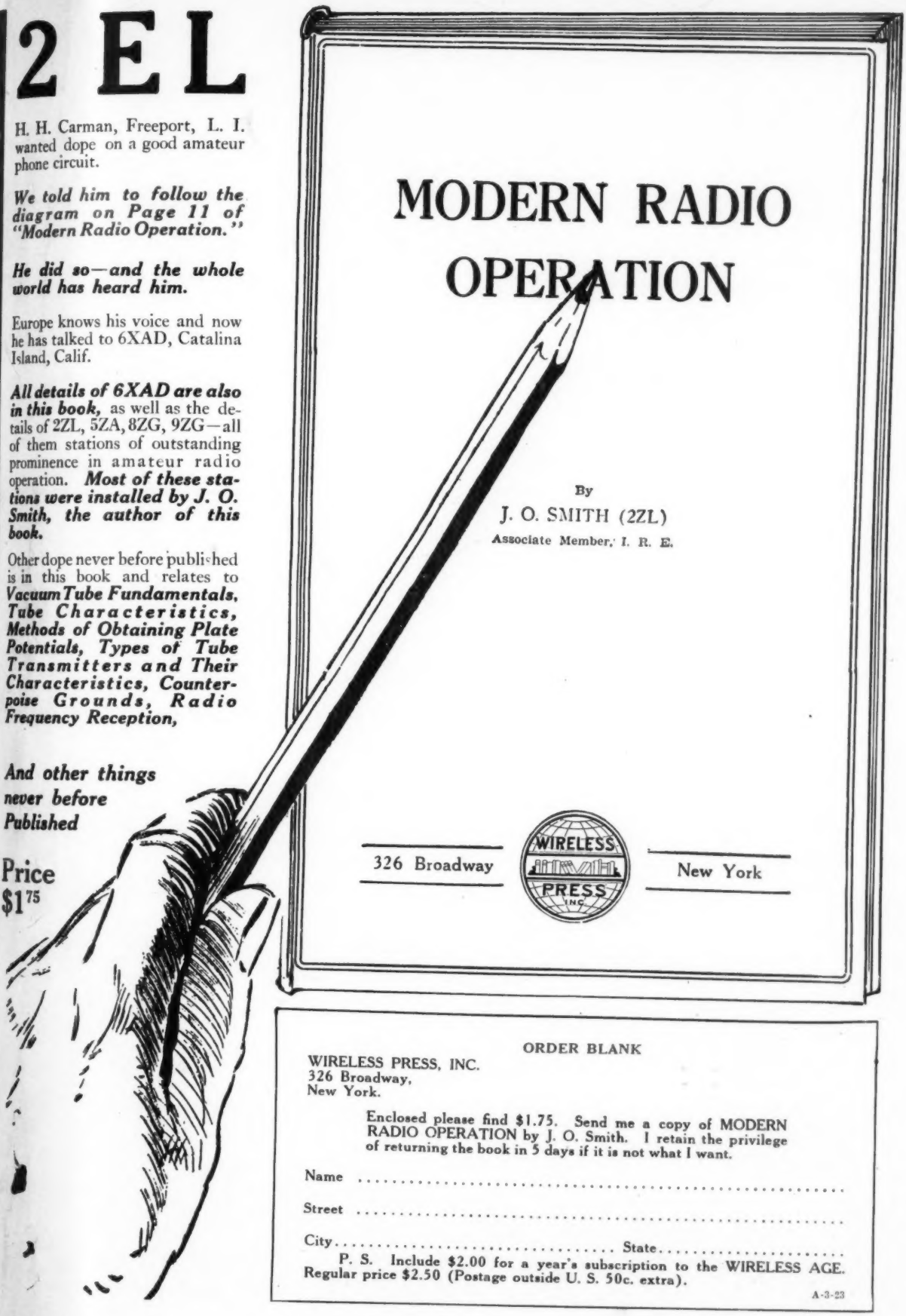

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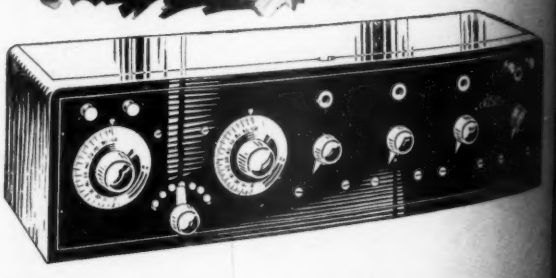

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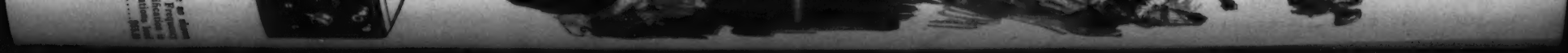
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